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INVENTORY OF PHYSICAL AND CULTURAL ELEMENTS, MIDDLE MISSISSIPPI RIVER FLOODPLAIN (RIVER REACH - ST. LOUIS, MISSOURI, TO CAIRO, ILLINOIS)

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Army Engineer Waterways Experiment Station
Vicksburg, Mississippi

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A general environmental inventory of physical and cultural elements in the Middle Mississippi River floodplain (St. Louis, Missouri, to Cairo, Illinois) is provided as a reference source for preparation of environmental impact statements. Physical elements discussed include geology, soils, and climate. Cultural elements are population, economic conditions, waterborne commerce, archeology, history, outdoor recreation, and land use. Geological data, including maps prepared at a scale of 1:250,000, are presented for regional

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20. ABSTRACT (Continued)

bedrock geology, structural geology (including seismic activity), economic geology, and physiography. Other geology-related items discussed are groundwater geology, historical geology, and rare and unusual geological features. Available maps and narrative descriptions for soils in the Missouri and Illinois counties bordering the river channel are presented for soil classifications relevant to agricultural use. Monthly averages of temperature and precipitation for St. Louis and Cairo, climatic effects on agriculture, and severe weather are discussed. Trends in waterborne commerce commodity groups are illustrated graphically for 1950-1970. Land use maps of the floodplain at a scale of 1:24,000 show locations of woodland areas, agricultural land use, water bodies, major industrial and commercial sites, and cities and towns. Also included on these maps are archeological and historical sites. Recreational facilities and points of interest are located on base maps at a scale of 1:24,000.

PREFACE

The study reported herein was performed by the U. S. Army Engineer Waterways Experiment Station (WES) for the U. S. Army Engineer District, St. Louis (SLD). A total of $17,000 provided for this study was distributed as follows: (a) $6000 for reporting on the geology, soils, and climate in the study area, and (b) $11,000 for reporting on population factors, economic conditions, waterborne commerce, land-use mapped at a scale of 1:24,000, archeological elements, historical elements, and outdoor recreation.

This study was one of several approved in the "Study Plan for an Environmental Inventory and Assessment of the Mississippi River 9-ft Channel Project Between St. Louis, Missouri, and Cairo, Illinois." MAJ W. P. Emge, Office of Environmental Studies (OES),* WES, was responsible for coordinating and monitoring all work performed under the blanket study plan.

This study was conducted under the direct supervision of Mr. J. K. Stoll, Chief, Environmental Simulation Branch (ESB), and under the general supervision of Messrs. W. G. Shockley, Chief, Mobility and Environmental Systems Laboratory (MESL), W. E. Grabau, Chief, Environmental Systems Division (ESD), and MAJ W. P. Emge, OES. Messrs. E. A. Dardeau, Jr., ESB, and H. K. Woods of the Engineering Geology Division, Soils and Pavements Laboratory, WES, contributed toward preparation of the maps and text on geological elements. Mr. B. T. Helmuth, ESD, prepared the land-use maps. Special acknowledgment is made to Dr. Charles Bareis of the Illinois Archeological Survey and his staff and to Mr. D. E. Evans of the Archeological Survey of Missouri for their assistance in furnishing information on archeological sites within the Middle Mississippi River floodplain. Acknowledgments are made also to Mr. W. G. Farrar, Director, Illinois Historic Landmark Survey, and to Ms. W. L. Holmes, Missouri State Historical Survey and Planning Office, for their assistance in furnishing information on historical sites in

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* OES became part of the Environmental Effects Laboratory in July 1974.

the floodplain. This report was written by Mr. Stoll and CPT R. D. Brown, formerly of ESB.

Directors of WES during the study and preparation of the report were BG E. D. Peixotto, CE, and COL G. H. Hilt, CE. Technical Director was Mr. F. R. Brown.

CONTENTS

CONVERSION FACTORS, U. S. CUSTOMARY TO METRIC (SI) UNITS OF MEASUREMENT

U. S. customary units of measurement used in this report can be converted to metric (SI) units as follows:

Multiply	By	To Obtain
inches	2.54	centimeters
feet	0.3048	meters
yards	0.9144	meters
miles (U. S. statute)	1.609344	kilometers
acres	4,047	square meters
acre-feet	43,560	cubic meters
square miles (U. S. statute)	2.58999×10^6	square meters
bushels (U. S.)	0.03524	cubic meters
gallons per minute	0.0631	liters per second
tons (short)	0.90718	metric tons
Fahrenheit degrees	5/9	Celsius degrees or Kelvins*

* To obtain Celsius (C) readings from Fahrenheit (F) readings, use the following equation: $C = (F - 32)/1.8$. To obtain Kelvin (K) from Fahrenheit, use: $K = (F + 459.67)/1.8$.

INVENTORY OF PHYSICAL AND CULTURAL ELEMENTS, MIDDLE MISSISSIPPI RIVER FLOODPLAIN (RIVER REACH - ST. LOUIS, MISSOURI, TO CAIRO, ILLINOIS)

PART I: INTRODUCTION

Background

1. Prior to the River and Harbor Acts of 21 January 1927 and 3 July 1930, navigation on the Mississippi River was extremely hazardous, and people living in the floodplain were subject to frequent floods. They petitioned the Federal Government to provide a more navigable waterway and flood protection works. Those acts authorized a project to obtain and maintain a 9- by 300-ft* channel for navigation from the confluence of the Missouri River to the confluence of the Ohio River (Middle Mississippi River). Under current design criteria, a dependable 9-ft channel can be obtained and maintained by extending and/or constructing dikes roughly perpendicular to either or both bank lines into the river throughout the project area, thereby constricting the river to an average width of 1500 ft.

2. The National Environmental Policy Act of 1969 requires that the U. S. Army Engineer District, St. Louis (SLD), prepare an Environmental Impact Statement (EIS) for the 9-ft channel project. Accordingly, the SLD allocated funds to the U. S. Army Engineer Waterways Experiment Station (WES) to perform an overall environmental inventory, assessment of data, and analysis of relations of physical, biological, chemical, and cultural elements within the project area, to provide a reference source for preparing the EIS. The SLD will predict the qualitative and quantitative impacts of the river regulating works based on the total

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* A table of factors for converting U. S. customary units of measurement to metric (SI) units is presented on page 4.

study effort and will prepare the EIS. Additional overall objectives of this study were to provide input for a comprehensive data base for use in better environmental planning in order to preserve or improve the areas riverward of the levees as habitats for biological communities.

Purpose and Scope

3. The purpose of the study reported herein was to provide a general inventory of specified physical and cultural elements in the Middle Mississippi River floodplain between Cairo, Illinois, and St. Louis, Missouri (levee to levee between river mile 0.0 and 40.0 and bluff to bluff between mile 40.0 and mile 170.0).

4. Fieldwork was excluded from all parts of this study. Pertinent data on the physical elements (geology, soils, and climate) were compiled through literature review and consultation with acknowledged specialists. Maps at a scale of 1:250,000 were prepared to show physiography, structural geology, regional geology, and economic geology. Other geology-related items included for consideration were groundwater geology, historical geology, and rare and unusual geological features. Available soils maps were obtained. Climatological elements included monthly averages of precipitation and temperature, and types and occurrences of severe weather.

5. Data on the cultural elements (population, economic conditions, waterborne commerce, land use, archeological elements, historical elements, and outdoor recreation) were compiled through literature review and consultation with acknowledged specialists. Land-use maps of the river floodplain were prepared at a scale 1:24,000, from available aerial photographs and topographic maps. The land-use maps show woodland areas, agricultural land, water bodies, major industrial and commercial sites, cities and towns, and archeological and historical sites.

Approach

6. Because of the limited monies provided for the work,

investigation of any of the physical or cultural elements in great detail was impossible. The approach used was to gather as much available information as possible in the time allowed for each element and use this source material in preparing this report. Land use was mapped directly from aerial photographs and topographic maps, and no other source materials were used. Considerable data reduction was required to produce the climatological, waterborne commerce, and economic data.

PART II: PHYSICAL ELEMENTS

Geology

7. General geology data for the Middle Mississippi River floodplain are presented for the elements of physiography, structural geology, groundwater geology, regional geology, historical geology, and economic geology. Current geological literature and maps were obtained by visits to the state geological surveys of Illinois and Missouri, as well as to other offices.* Reference material available in the WES library and Engineering Geology and Rock Mechanics Division of the Soils and Pavements Laboratory, WES, was used to supplement that provided by the state agencies. An exhaustive literature search and review was not possible, and fieldwork was beyond the scope of this study. This section of the report, therefore, is not a detailed treatment of the geology of the Middle Mississippi River floodplain, but rather presents general knowledge useful for making gross environmental assessments. Geological references are in the text and a bibliography of selected geological literature is included at the end of this report to provide sources of information for detailed reading and study.

Physiography

8. Physiography is the science that deals with the study of the genesis and evolution of landforms and may include treatment of the atmosphere and ocean. Fenneman[1] states its relation to geology and geography as follows:

> As a study of processes, principles, laws, and types, physiography is a branch of geology. In its areal or distributional phase, it is a branch of geography. Since the study of the distributional phase is inseparable from that of principles, physiography may be said to represent the overlap of the two major sciences.

9. In the United States there are a number of physiographic divisions called provinces. Boundaries, in some cases, are quite sharp; in

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* See addresses in Appendix A at the end of this report.

other instances, the dividing lines represent broad generalizations. Fenneman's[1] divisions have been used in this report, and parts of the following provinces occur in or near the study area: (a) Coastal Plain, (b) Ozark Plateaus, (c) Central Lowland (east and west of the Mississippi River), and (d) Interior Low Plateau. Figure 1 shows the boundaries of these physiographic provinces in the Middle Mississippi River region.

10. Coastal Plain. The Coastal Plain is a coastal geosyncline, the surface of which dips generally seaward. Significant inward deviations occur in the vicinity of the Mississippi and Rio Grande Rivers and in northeast Texas.

11. The southern part of the study area to the latitude of Cape Girardeau, Missouri, is in the Coastal Plain (Figure 1). Specifically, this part of the Coastal Plain province is known as the Mississippi Embayment, a broad structural trough between the Appalachain Uplift to the east and the Ozark Highlands to the west, submerged during a large part of its history. When this embayment emerged, the Mississippi River followed its axis to the Gulf of Mexico. Despite the fact that aggradation did occur, the trough between the bluffs is due largely to excess erosion.

12. An important divide in the Mississippi Embayment is Crowley's Ridge, a remnant of the higher, nearly level plain in which the present alluvial trough was carved. It extends from Thebes, Illinois, southwestward to Helena, Arkansas, and is assumed to have served as a divide between the ancient Mississippi and Ohio Rivers. Presumably during the Pleistocene epoch, the Mississippi broke through this ridge and joined the Ohio at its present location, Cairo, Illinois. From Cape Girardeau to Commerce, Missouri, the Mississippi flows through high bluffs in a gap of a ridge of hard, massive limestone and shale of Ordovician age.

13. Ozark Plateaus. The Ozark Plateaus cover an area of 40,000 square miles ranging on both sides of the Mississippi River from Cape Girardeau, Missouri, to Grand Tower, Illinois, and from Grand Tower north to Festus, Missouri, on only the Missouri side of the river (Figure 1). Although the majority of this physiographic province is in

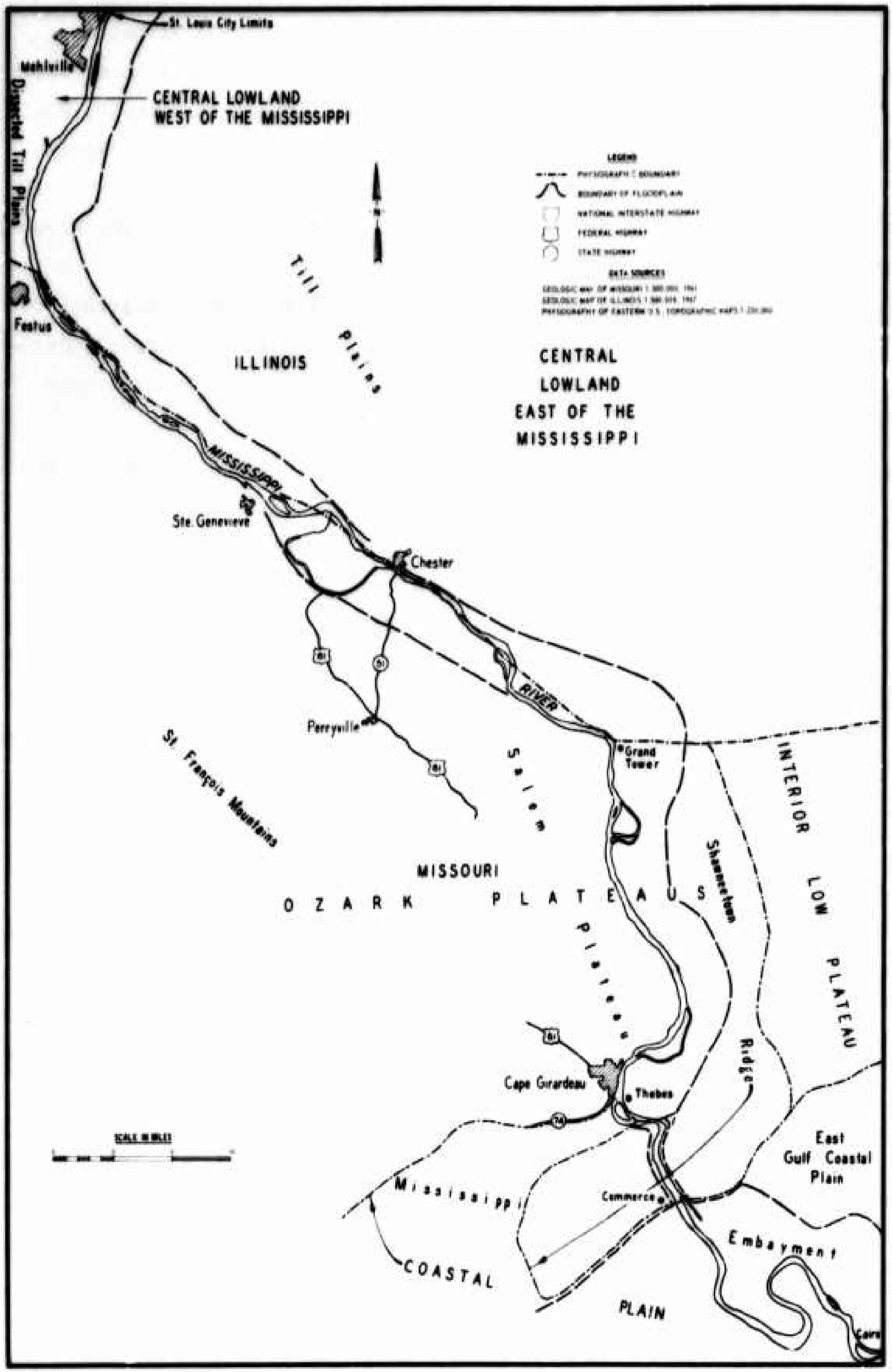

Figure 1. Physiography of the Middle Mississippi River region

central and southern Missouri, portions of it extend into southwestern Kansas, northeastern Oklahoma, northwestern Arkansas, and eastern Illinois. Fenneman[1] describes the form of the Ozark Plateaus as "...that of an asymmetrical dome steeper on the east than on the west and breaking off rather abruptly on the south." The entire region, which is one of strong rocks and submature dissection, is hilly and best suited for dairy, cattle, and poultry farming. The province is unglaciated, and the uplands generally are covered by a shallow thickness of residual clay soil changing to colluvium at the base of slopes bordering floodplains along the major streams and tributaries.

14. Major subdivisions of the Ozark Plateaus are the Boston Mountains, Springfield Plateau, St. Francois Mountains, and the Salem Plateau. That portion of the study area falling within the Ozark Plateaus is wholly within the Salem Plateau (Figure 1). The Salem Plateau consists of remnants of maturely dissected, rolling, upland surface, preserved largely on Cambrian and Ordovician rocks, even though some rocks of later Paleozoic age remain on the north and northeast flanks. Much of the surface of the Salem Plateau has been destroyed by stream action.[2]

15. In the Missouri portion of the Ozark Plateaus, beds dip steeply westward, and a series of cuestas is well developed. The most important of these are the eastward facing Crystal and Burlington Escarpments. The Crystal Escarpment owes its existence to the friable St. Peter sandstone (Ordovician) outcropping under the edge of strong middle-Ordovician sandstones. The less resistant St. Peter sandstone erodes and leaves overlying rocks unsupported, causing them to break loose. This cyclic mechanism maintains the prominent escarpment. The Burlington Escarpment, the most persistent of all escarpments in this province because of the cherty and resistant Burlington limestone, follows the Missouri River to its mouth, crosses to the Illinois side of the Mississippi River, and again returns to the west side of the Mississippi at Ste. Genevieve, Missouri. In the Illinois portion of the Ozark Plateaus, the Ozark dome extends in a more linear uplift and is referred to as the Shawneetown Ridge. The Illinois rocks, in ascending order

from Ordovician to Mississippian, are strong limestones. Beds dip northward toward the syncline of central Illinois. The steep bluffs on the Mississippi River reach a height of 400 ft as the river flows through the Ozark Plateaus province.

16. <u>Central Lowland.</u> Fenneman[1] the Central Lowland east of the Mississippi River and the area to the west of the river as major subdivisions of the Central Lowland physiographic province.

17. <u>Central Lowland east of the Mississippi River.</u> The Central Lowland east of the Mississippi ranges from east of Lake Ontario to the Mississippi River. The boundary from northern Ohio to around St. Louis is approximately at the edge of the glacial drift, and according to Fenneman,[1] "Glaciation dominates most of the landscape, but it probably created as much variety as it destroyed." In the portion of the Central Lowland physiographic province east of the Mississippi River, there are three subdivisions: (a) Great Lakes section, (b) Driftless section, and (c) Till Plains section.

18. The east Central Lowlands portion of the study area falls entirely within the Till Plains section (Figure 1). The character of this subdivision, now one of little relief, is due to complete burial of preglacial features. It is difficult to differentiate between the Till Plains section and the Great Lakes section to the north of it. Fenneman[1] states that

> If justification of the two sections be attempted on geologic terms, the Till Plains section may be distinguished as that portion of the glaciated area east of the Mississippi River wherein the movement of ice was less controlled and diverted by deep valleys.

Cuestas and lowlands are more dominant in the Great Lakes section than in the Till Plains section.

19. In the Till Plains section, the main <u>preglacial</u> structural features are the northern part of the Cincinnati anticline, which brings Ordovician rocks to the surface, and the southern Illinois syncline which "...retains its Carboniferous coal measures even where the surface is very low."[1] On the west side, these lowlands of southern Illinois border the trench of the Mississippi River.

20. The Illinoian ice sheet covered all of the Till Plains section, including the southern section, but the Wisconsin sheet did not reach western or southern Illinois. Below St. Louis ice climbed the dip slope of the Mississippian cuesta to the west. Where the Illinoian drift was not covered by the Wisconsin sheet, it is covered with loess. The origin of this loess is believed to be "glacial flour" distributed first by water then by wind lifting it from the floodplain. Along the Mississippi River this material may reach a thickness of 50 ft.

21. The rocks in the Till Plains section have been worn down many hundreds of feet. Fenneman[1] believes that "...the Till Plains section was reduced to a peneplain at least once, and parts of it several times." The Mississippi River in this area flows through a trench 400 to 500 ft deep.

22. Central Lowland west of the Mississippi River. This portion of the Central Lowland province lies, as the name implies, to the west of the Mississippi River and extends across the Great Plains of the central United States and Canada. The same general descriptors apply to this portion as to the eastern portion of the province. The three subdivisions are (a) the Western Young Drift section, (b) the Osage section, and (c) the Dissected Till Plains section. The study area is located in the Dissected Till Plains section.

23. In general this latter section is a flat till plain in a submature to mature erosion cycle with relief being 100 to 300 ft. It is covered by loess, varying in depth from a few feet to a maximum of 90 ft adjacent to the large rivers. Fenneman[1] states that "This section is distinguished from the Till Plains on the east and from the (western) Young Drift section on the north by the stage it has reached in the postglacial erosional cycle." Older Palezoic rocks beneath the Mississippian system are found in only the narrow valleys of the two rivers (i.e. Mississippi and Missouri). The land surface seems continuous with a peneplain east of the rive (Till Plains section). There are two glacial stages recognized in the Dissected Till Plains: (a) Kansan and (b) Nebraskan. Eighty percent of this area now, however, has an erosional surface, hence the name Dissected Till Plains.

24. Specifically, the study area is in the southeastern portion of the Dissected Till Plains and ranges on the Missouri side to the Mississippi River from Festus, Missouri, in the Ozark Plateaus to the northern terminus of the Middle Mississippi River floodplain at St. Louis. The Dissected Till Plains section is across the Mississippi from the Till Plains section of Illinois. Thickness of loess on the bluffs (average 40 to 50 ft) has obscured older relief. The river flows through a 400- to 500-ft deep trough on the east boundary of this province.

25. Interior Low Plateau. This province falls completely outside the Middle Mississippi River floodplain. The Interior Low Plateau is contiguous with the Ozark Plateaus in southern Illinois some 10 miles east of the Mississippi River (Figure 1). The terms "low" and "plateau" seem to be contradictory, but they refer to relative elevations, since they describe an area between the Till Plains, the Coastal Plain, the Ozark Plateaus, and the Appalachian Plateau. The sections making up this province are (a) the Highland Rim, (b) the Nashville Basin, (c) the Bluegrass, and (d) the Shawnee.

26. The Shawnee section is of interest because of its proximity to the study area, specifically the Shawneetown Ridge of the Ozark Plateaus. In this section, according to Fenneman, the rock succession is "...depressed in a syncline pitching northwestward...." The stratigraphic sequence "...beveled by an old surface now dissected is accountable for the major features of relief."[1] Two prominent cuestas form a wide area of rugged topography.

27. In the eastern part of the Shawnee section, a thin and porous sandstone cover has allowed access of surface waters to the underlying soluble limestone, and as a result, there are numerous sink holes and caves, including Mammoth Cave. In the western part of the Shawnee section, which is located near the study area, the two cuestas continue almost to the Ozark Uplift of southern Illinois. There are numerous faults south of the two cuestas in this area, but Fenneman[1] states that "...since the faults antedated that last peneplain, they do not affect the landscape, except where the rocks on opposite sides (of small

streams which follow these faults) differ in hardness." Downthrown blocks form present hills and ridges, and the topography of this portion of the Shawnee section is equal to that of the nearby cuestas. In this area is the great fluorite district of the United States.

Structural geology

28. Structural features within the limits of the study area are confined to monoclines, domes, folds, anticlines, and faults (Figure 2). Some of these features are associated with the Ozark Uplift.

29. McCracken[3] states that

> At least six episodes of deformation have occurred in Missouri beginning with intense faulting and volcanic activity in the Precambrian followed by intermittent but persistent uplift of the Ozark region during the Paleozoic and Mesozoic. Sharp rejuvenation of the Mississippi embayment took place in post Paleocene-pre Pliocene time.* Pleistocene stream terraces, entrenched meanders, and seismic activity all indicate that uplift is continuing.

(Figure 3 contains a geological time scale.)

30. Structural features. Within the study area, the following significant structural features can be found (Figure 2): (a) Valmeyer anticline, which crosses the river midway between Festus and St. Louis; (b) Crystal City anticline at Festus; (c) Plattin Creek anticline, trending northeastward to Crystal City (east of Festus); (d) Ste. Genevieve fault system, a series of several folds and faults, described by McCracken[3] as "...downthrown to the north and east," extending from Franklin County, Missouri (approximately 50 miles southeast of St. Louis), along the river crossing at Perry County (Figure 2) and into Illinois; (e) Brooks dome in Cape Girardeau County, Missouri, 4 miles north-northeast of Cape Girardeau; (f) Cape Girardeau fault, a minor fault in Cape Girardeau County, Missouri; (g) Thebes anticline and associated faults and folds, described by Pryor and Ross[4] as follows: "The axis of the broad Thebes Anticline extends east southeast through Thebes (Illinois) and becomes less pronounced towards Olive Branch" (a

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* Within the Tertiary period approximately 7 to 50 million years ago.

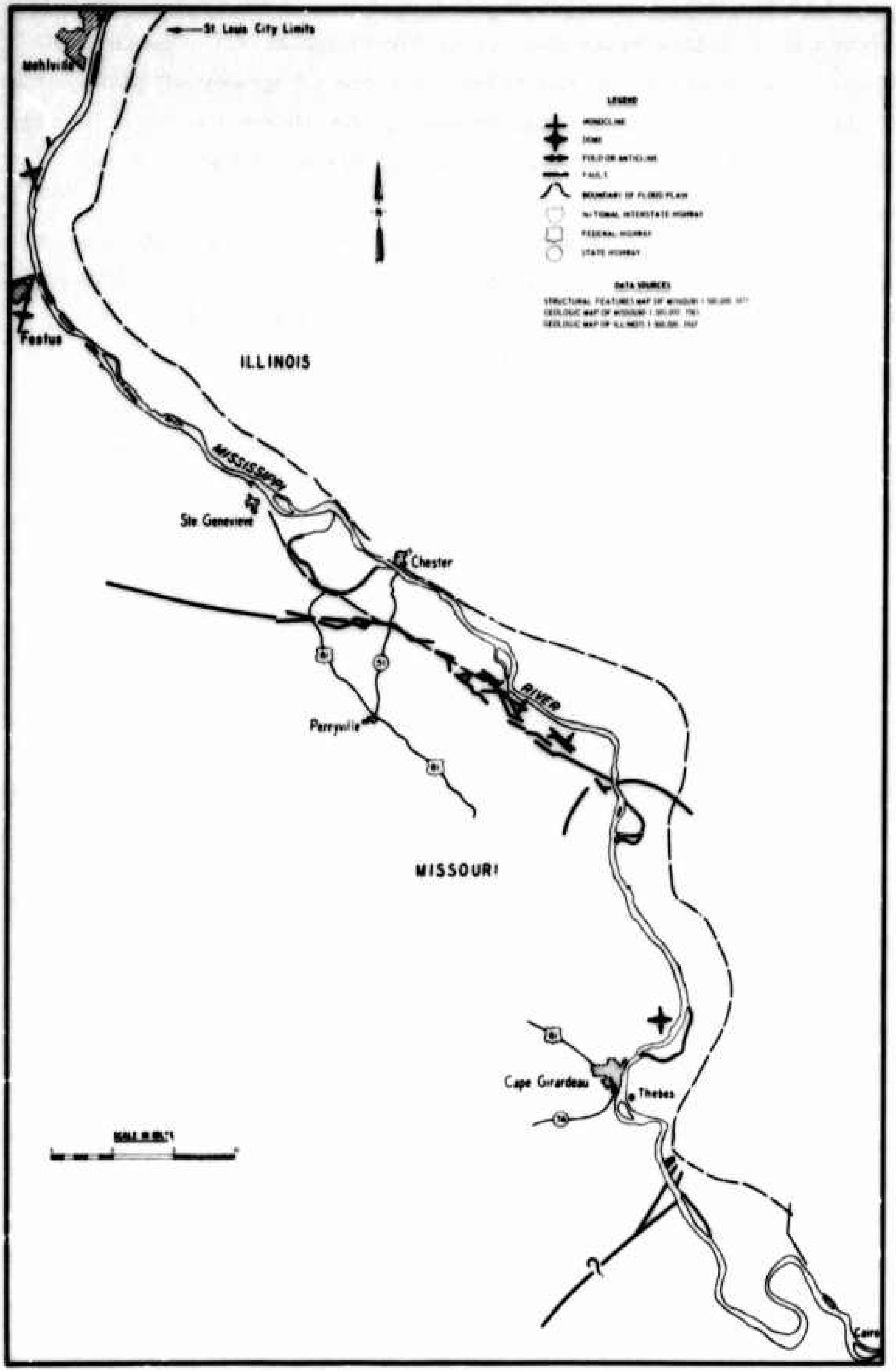

Figure 2. Structural geology of the Middle Mississippi River region

GENERALIZED GEOLOGICAL COLUMN FOR THE MIDDLE MISSISSIPPI RIVER FLOODPLAIN AND VICINITY

ERA*	SYSTEM	SERIES	STAGE	GROUP	FORMATION	YEARS BEFORE PRESENT	
CENOZOIC	QUATERNARY	PLEISTOCENE "ICE AGE"	RECENT			7,000 TO PRESENT	AGE OF MAMMALS
			WISCONSINAN (GLACIAL)			75,000	
			SANGAMONIAN (INTERGLACIAL)				
			ILLINOIAN (GLACIAL)				
			YARMOUTHIAN (INTERGLACIAL)				
			KANSAN (GLACIAL)				
			AFTONIAN (INTERGLACIAL)				
			NEBRASKAN (GLACIAL)			1,000,000	
	TERTIARY					63,000,000	
MESOZOIC	CRETACEOUS	GULFIAN				135,000,000	AGE OF REPTILES
PALEOZOIC	PENNSYLVANIAN	DES MOINESIAN		KEWANEE (ILLINOIS)	SPOON (ILLINOIS)		AGE OF AMPHIBIANS AND EARLY PLANTS
		ATOKAN		McCORMICK (ILLINOIS)	ABBOT (ILLINOIS)		
		MORROWAN			CASEYVILLE (ILLINOIS)	310,000,000	
	MISSISSIPPIAN	CHESTERIAN (MISSOURI) — UPPER CHESTERIAN (ILLINOIS)					
		LOWER CHESTERIAN (ILLINOIS)					
		MERAMECIAN (MISSOURI) — UPPER VALMEYERAN (ILLINOIS)					
		MIDDLE VALMEYERAN (ILLINOIS)					
		LOWER VALMEYERAN (ILLINOIS)					
		OSAGEAN (MISSOURI)					
		KINDERHOOKIAN				345,000,000	
	DEVONIAN	MIDDLE DEVONIAN (ILLINOIS)					AGE OF FISHES
		LOWER DEVONIAN (ILLINOIS)				405,000,000	
	SILURIAN					425,000,000	
	ORDOVICIAN	CINCINNATIAN	RICHMONDIAN (MISSOURI)	MAQUOKETA (ILLINOIS)	MAQUOKETA (MISSOURI)		AGE OF INVERTEBRATES
		CHAMPLAINIAN	MOHAWKIAN (MISSOURI)	GALENA (ILLINOIS)			
				PLATTENVILLE (ILLINOIS)	DECORAH (MISSOURI)		
					PLATTIN (MISSOURI) SUBGROUP IN ILLINOIS		
			CHAZYAN (MISSOURI)	ANCELL (ILLINOIS)	JOACHIM (MISSOURI)		
					DUTCHTOWN (MISSOURI)		
					ST. PETER (MISSOURI)		
					EVERTON (MISSOURI)		
		CANADIAN			SMITHVILLE (MISSOURI)		
					POWELL (MISSOURI)		
					COTTER (MISSOURI)		
					JEFFERSON CITY (MISSOURI)	500,000,000	
	CAMBRIAN					600,000,000	
	PRECAMBRIAN						

*THERE IS NO UNIVERSALLY ACCEPTED TIME-STRATIGRAPHIC EQUIVALENT FOR THE GEOLOGICAL TIME UNIT ERA. THE EUROPEANS HOWEVER USE ERATHEM.

SOURCES: THE STRATIGRAPHIC SUCCESSION IN MISSOURI, MISSOURI GEOLOGICAL SURVEY AND WATER RESOURCES, 1961
GEOLOGICAL MAP OF MISSOURI, MISSOURI GEOLOGICAL SURVEY AND WATER RESOURCES, SCALE 1:500,000, 1961
GEOLOGICAL MAP OF ILLINOIS, ILLINOIS GEOLOGICAL SURVEY, SCALE 1:500,000, 1967
GEOLOGICAL TIMETABLE, F. W. B. VAN EYSINGA, 1977

Figure 3. Generalized geological column for the Middle Mississippi River region

distance of approximately 6 miles); (h) Albright Creek fault in Scott County, Missouri (Figure 2), and exposed at the mouth of Albright Creek; and (i) English Hill Fault in Scott County, Missouri, where loess has been faulted. McCracken[3] states that, "The fact that the loess (Pleistocene) is affected by this fault shows late movement in the area. This remains an active seismic area.

31. Seismic activity. Cairo, at the southern end of the study area, is 34 miles northeast of New Madrid, Missouri, which is near the epicenter of one of the most devastating earthquakes to be felt on the North American Continent. Saucier[5] states that actually a series of three earthquakes, which occurred between December 1811 and February 1812, comprise what is commonly thought of as the New Madrid Earthquake. Since 1816, 100 earthquakes have been felt in this area, most of which were minor tremors. The southern half of the Middle Mississippi floodplain has a seismic risk classification of 3 (as has California) and the northern half a classification of 2, on a seismic risk scale of 0 to 3. Had it not been for the 1811-1812 earthquake series, the area would, no doubt, be classified as a minor seismic region, but because of this major earthquake series, studies are being conducted (e.g. Saucier[5]) to determine the possibility of recurrence of such seismic events.

32. These earthquakes are responsible for a number of the surficial structures in or near the southern half of study area, i.e. "...sand blows, fissures, and related phenomena caused by liquefaction of shallow subsurface sand and its extrusion to the surface."[5]

33. Present-day course of the Middle Mississippi River. Horberg[6] describes the present-day course of the Middle Mississippi River, emphasizing the physiographic and structural relations. The counties in his discussion are all in Illinois (Figure 4):

> ...The present Mississippi...for a short distance in the vicinity of St. Louis flows in a broad valley. ...A few miles below St. Louis the valley narrows, and for more than 100 miles the river occupies a rock trough incised across the eastern flank of the Ozark Plateaus. The discordance with structure is emphasized by the fact that within this distance the valley, from north to south: (a) crosses the Meramec-Osage

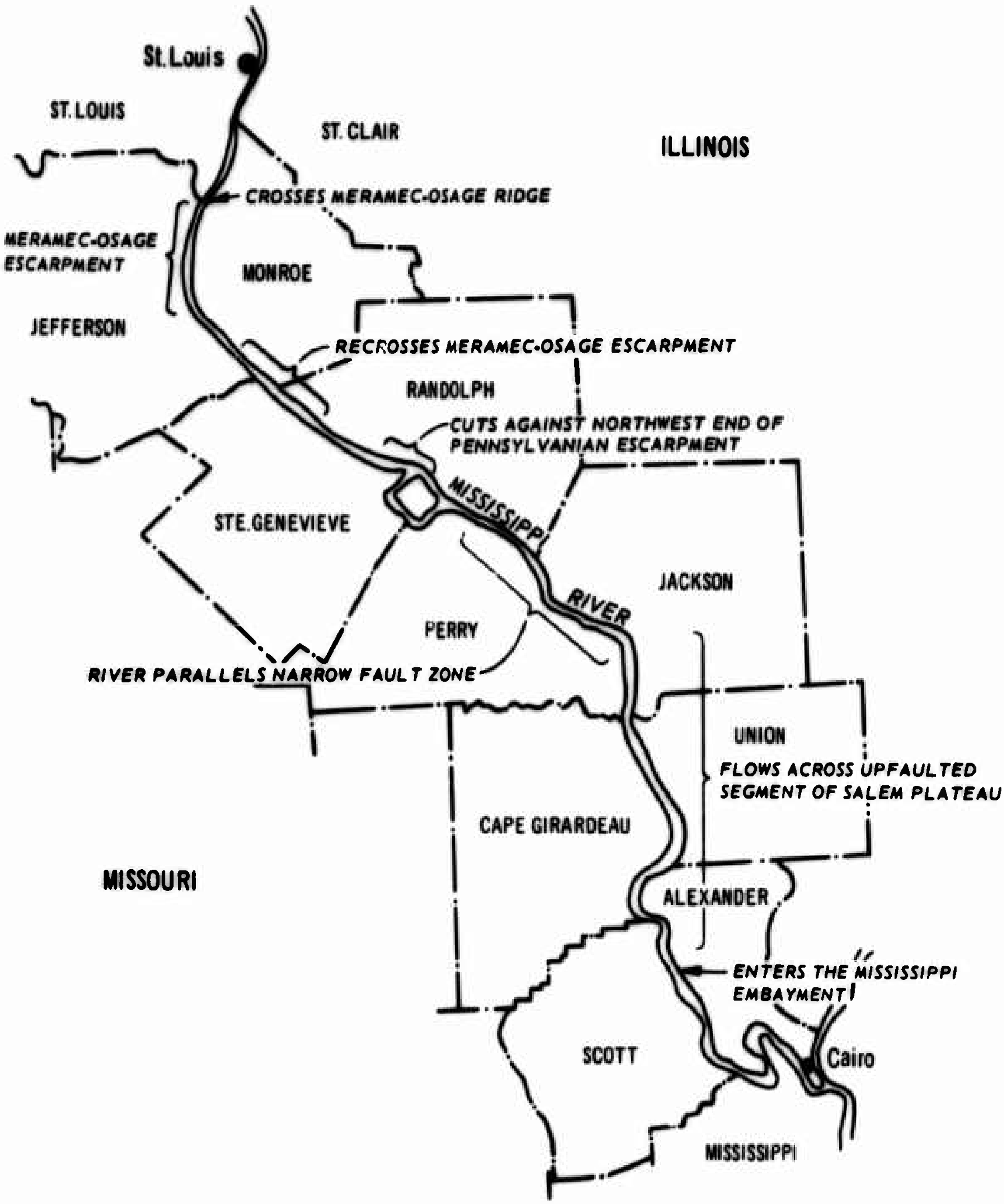

Figure 4. Structural geology related to present-day course of Middle Mississippi River

> ridge in northern Monroe and southern St. Clair counties; (b) turns southward for a short distance in central Monroe county along the western margin of the Meramec-Osage escarpment following the strike of the upper Ordovician strata; (c) swings southeastward and recrosses the escarpment in southern Monroe and western Randolph counties; (d) cuts against the northwest end of the Pennsylvanian escarpment and parallels a narrow fault zone in southern Randolph and Jackson counties; and (e) turns southward across an upfaulted segment of the Salem Plateau in Union and Alexander counties. In central Alexander County the valley finally enters the Mississippi Embayment of the Coastal Plain and widens into the broad valley at the southern tip of the state (i.e. Illinois).
>
> In addition to crossing structurally controlled ridges developed on the eastern flank of the Ozark structured dome, it has been proposed that peneplain remnants in southeastern Missouri form a surface that has been warped into a topographic dome....

Groundwater geology

34. Horberg[6] states that "...large underdeveloped groundwater resources occur within the glacial deposits filling major bedrock valleys through the state (Illinois)...." and that "...the thickest and most continuous aquifers are within the present Mississippi...valley which in large part coincide with preglacial valleys...." Valley fill ranges in thickness from 120 to 175 ft and is composed mainly of sand and gravel. In the St. Louis-East St. Louis area, significant withdrawals of groundwater have taken place. In the study area south of St. Louis, only minor amounts of groundwater have been withdrawn, so the entire Middle Mississippi floodplain, with the possible exception of the narrows between Alexander County, Illinois, and Scott County, Missouri, has large undeveloped groundwater reserves.[6]

35. Robertson et al.[7] plot and tabulate water-well yield from "representative deep and/or high yield water wells..." in Missouri. In the study area, well depths range from 67 to 1302 ft with the majority being in the 400- to 700-ft range. Most wells have yields of 50 or fewer gallons per minute (gpm); a few wells have yields in the range of 50 to 200 gpm; and one well in Scott County, Missouri, has a yield of 500 to 1000 gpm.

36. Baker[8] and Bergstrom and Walker[9] discuss the groundwater geology of the East St. Louis area in their reports. Baker[8] states, "The first significant withdrawal of groundwater in the East St. Louis area started in the late 1890's. Prior to 1900 groundwater was primarily used for domestic and farm supplies; since 1900 pumpage has been mostly for industrial use." Bergstrom and Walker[9] feel that only the flood-plain fill material (i.e. bulk alluvium and glacial outwash) aquifers are suited for large-quantity production, as the bedrock aquifers are likely to contain highly mineralized water. Aquifers are recharged by rainfall, floods, and percolation from the Mississippi River.

37. Horberg,[6] in discussing the possibility of obtaining groundwater in a specific locality, states that

> ...the available data are inadequate to assure supplies at specific locations. For this reason, and because of the sudden lateral variations in the permeability of most glacial deposits, electrical-resistivity surveys and test borings are usually required in order to discover the most favorable locations within an area.

<u>Regional geology</u>

38. The age of the geologic section exposed at the surface of the study area ranges from 500,000,000 years for rocks of the lower Ordovician System to the present for unconsolidated sediments of recent stage of the Quaternary System. Figure 3 is a generalized geological column for the Middle Mississippi valley showing the geological ages, and Figure 5 is a map of the regional geology of the study area. Names of geologic units are not always the same in Missouri and Illinois, as mapping was done by different agencies at different times. Below is a brief description of mapped units in the Middle Mississippi River region:[10,11,12]

39. <u>Ordovician system.</u> The Ordovician system in the study area is composed of the Canadian, Champlainian, and Cincinnatian series.

- <u>a</u>. <u>Canadian series.</u> (Smithville, Powell, Cotter, and Jefferson City formations found only in Missouri.) These four formations, which are mapped as one unit, consist mostly of dolomite. The Smithville formation, approximately 150 ft thick, contains small amounts of chert and is

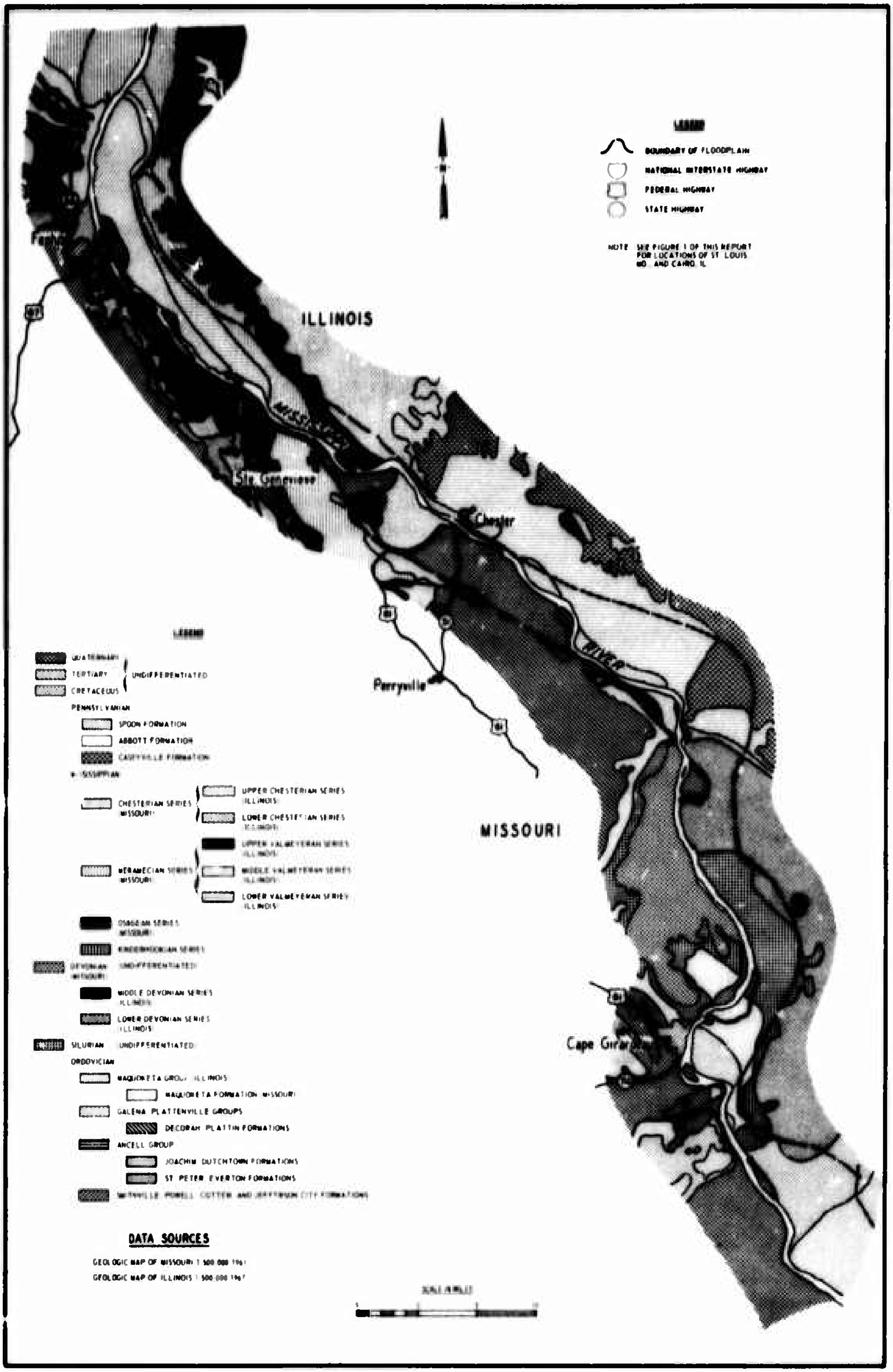

Figure 5. Regional geology of the Middle Mississippi River region

distinguished by the presence of fossils of bryozoa. In the Powell formation are interbedded finely crystalline, argillaceous dolomite and many thin beds of green shale; the formation ranges from 150 to 175 ft in thickness in the study area. The Cotter formation is "...normally medium to thinly bedded and contains intercalated beds of green shale and sandstone";[10] it reaches a thickness of approximately 450 ft. Lenses of orthoquartzite, conglomerate, and shale are locally present in the Jefferson City formation, and "...a stratigraphic succession of the Jefferson City formation in one locality is rarely duplicated in another locality, although there is a similarity";[10] formation thickness ranges from 125 to 350 ft.

b. Champlainian series.

(1) Chazyan stage, Ancell group (Joachim, Dutchtown, and St. Peter formations found in both Missouri and Illinois and the Everton formation found only in Missouri). In Illinois the Ancell group has been mapped as a single unit; in Missouri the Joachim and Dutchtown are mapped as one unit, and the St. Peter and Everton are mapped as another. The Joachim is a argillaceous dolomite containing interbedded limestone and shale; thickness in Missouri ranges from 50 to 175 ft and in Illinois from 60 to 385 ft. The Dutchtown formation is classed as a dolomite but contains interbedded limestone, sandstone, and shale; its thickness ranges from 20 to 170 ft in Missouri and from 0 to 200 ft in Illinois. The St. Peter is described by Howe and Koenig[10] as "typically a well-sorted quartzose sandstone"; in Missouri formation thickness is 10 to 100 ft, and in Illinois it is 65 to 300 ft. The Everton, which occurs only in Missouri, consists of mostly sandy dolomite with interbedded sandstone, limestone, and chert.

(2) Mohawkian stage.

(a) Plattenville group (Decorah and Plattin formations of Missouri). The Decorah and Plattin are mapped as a single unit. The Decorah formation is a shale unit with numerous interbedded limestone layers, some of which contain brachiopod fossils; it varies in thickness from a few feet to more than 40 ft. Howe and Koenig[10] describe the Plattin as one consisting of "...evenly bedded, dark gray, finely crystalline to sublithographic limestone which contains minor amounts of intercalated shales"; in the study area this formation reaches a thickness of 40 ft.

(b) Galena group. In Illinois the Galena and

Plattenville groups are mapped as a single unit. In general the two groups are a series of limestones containing interbedded shale and dolomite.

c. Cincinnatian series (Richmondian stage, Maquoketa group, Maquoketa formation). In Illinois the Maquoketa group is treated as a single unit. It consists of a series of limestones and shales. In Missouri the Maquoketa formation is described as "...typically a thinly laminated, silty, calcareous or dolomitic shale which locally contains modular and shaly lenses of limestone."[10] Fossils in the Maquoketa formation include mollusks, corals, and branchiopods. Average formation thickness in the vicinity of the study area is 100 ft.

40. Silurian system. In Illinois the Silurian is shown as a single map unit. It consists of a series of limestones with some interbedded shales and dolomites.

41. Devonian system. In Missouri the Devonian is mapped as a single unit representing "small remnants of dark gray to black cherty limestone."[12]

a. Lower Devonian series. In Illinois the entire Lower Devonian series is mapped as a single unit representing a series of limestones and cherts.

b. Middle Devonian series. The Middle Devonian series in Illinois consists of a series of sandstones, limestones, and shales.

42. Mississippian system.

a. Kinderhookian series. Although this series occurs in both Missouri and Illinois, it is mapped in only the Missouri portion of the study area. It consists of a series of shales, limestones, and siltstones.

b. Osagean series. This series occurring only in Missouri is "...characteristically composed of limestones which are crinoidal, cherty, generally coarsely crystalline and fossiliferous. None of the formations within the series is entirely free of chert."[10]

c. Meramecian (Missouri) or Valmeyeran (Illinois) series. In Missouri the Meramecian series is mapped as a single unit, and is composed chiefly of limestones and some dolomites. In Illinois the Valmeyeran is mapped as Lower, Middle, and Upper.

(1) Lower Valmeyeran. The Lower Valmeyeran is a series of limestones with some chert and shale beds.

(2) Middle Valmeyeran. The Middle Valmeyeran includes limestones, shales, and sandstones.

(3) Upper Valmeyeran. This unit is a sandstone and limestone sequence with some interbedded breccia, shale, and dolomite.

d. Chesterian series. This series is mapped as a single unit in Missouri consisting of "...crudely rhythmic repetitions of sandstone, shale, and limestone which crop out in the bluffs of the Mississippi River only in Ste. Genevieve and Perry Counties in an area of steeply dipping beds and of considerable faulting."[10] In Illinois the Lower and Upper Chesterian are mapped separately.

(1) Lower Chesterian. The Lower Chesterian consists of interbedded limestone and sandstone with some coal and chert.

(2) Upper Chesterian. This is composed of shale, limestone, and sandstone units as well as interbedded coal and chert.

43. Pennsylvanian system (found only in Illinois).

a. McCormick group.

(1) Caseyville formation. This formation consists of sandstone and shales as well as some gravel and coal.

(2) Abbot formation. The Abbot contains shale, sandstone, and coal beds.

b. Kewanee group (Spoon formation). The Spoon contains interbedded shale, sandstone, clay, limestone, and coal.

44. Cretaceous system. The Cretaceous is mapped as a single unit in both Missouri and Illinois. It is described as a sequence of interbedded sandstones and shales in Illinois and in Missouri as "...a succession of nonmarine sand, sandy clay, and clay,"[10] when discussing the McNairy formation and as "...a massive sandy, micaceous, fossiliferous, marine clay which is commonly glauconitic,"[10] when referring to the Owl Creek formation.

45. Tertiary system. The Tertiary system in both Missouri and Illinois appears as a single map unit. This consists of interbedded clays, sand, gravel, and shales in the two states.

46. Quaternary system. The Quaternary is shown as a single unit. It consists of sand and gravel, glacial till, loess, and alluvium.

Historical geology

47. A reconstruction of the geologic history of the Middle Mississippi floodplain would require a detailed field study. No detailed information is available in recent publications. Horberg[6] discusses the Pleistocene drainage history of the floodplain in his report, and Figure 6 traces the sequence of events that he describes.

48. According to Willman et al.:[11]

> The complex sequence of drainage events accompanying advances, and retreats of the various ice-sheets and the drainage systems of the interglacial stages are known only in part. In a few restricted areas fairly detailed histories have been worked out, but as a whole, the Pleistocene drainage history hangs largely by a few established events of major importance and upon the geographic relations of the bedrock valleys and drift-sheets....

49. Pre-Illinoian. The earliest ice sheet to enter the state was the Nebraskan which pushed across the ancient Iowa River from the west and probably covered a large part of the upland of western Illinois.[11] During this advance the headwaters of the Iowa above the lower rapids of the present Mississippi at Keokuk were probably diverted eastward past Rock Island into the ancient Mississippi, establishing a course which may have been maintained until Wisconsin time. Nebraskan ice may also have crossed the Middle Illinois bedrock valley into Scott County, but there is no evidence that there was other than a temporary deflection of the ancient Mississippi at that point. Except for the modification of the ancient Iowa, drainage in Illinois during the following Aftonian interglacial was much the same as in preglacial time.

50. The effects of the succeeding Kansan glaciation were more far-reaching. Glaciers advanced both from the northeast (Labradorean center) and the west (Keewatin), probably in that order, and together covered the greater part of the State.[11] As the result of the advance from the northeast, Mahomet Valley and its important north tributary, Newark Valley, appear to have been largely filled with drift, and the present Ohio and glacial Ticona systems were inaugurated. There is as

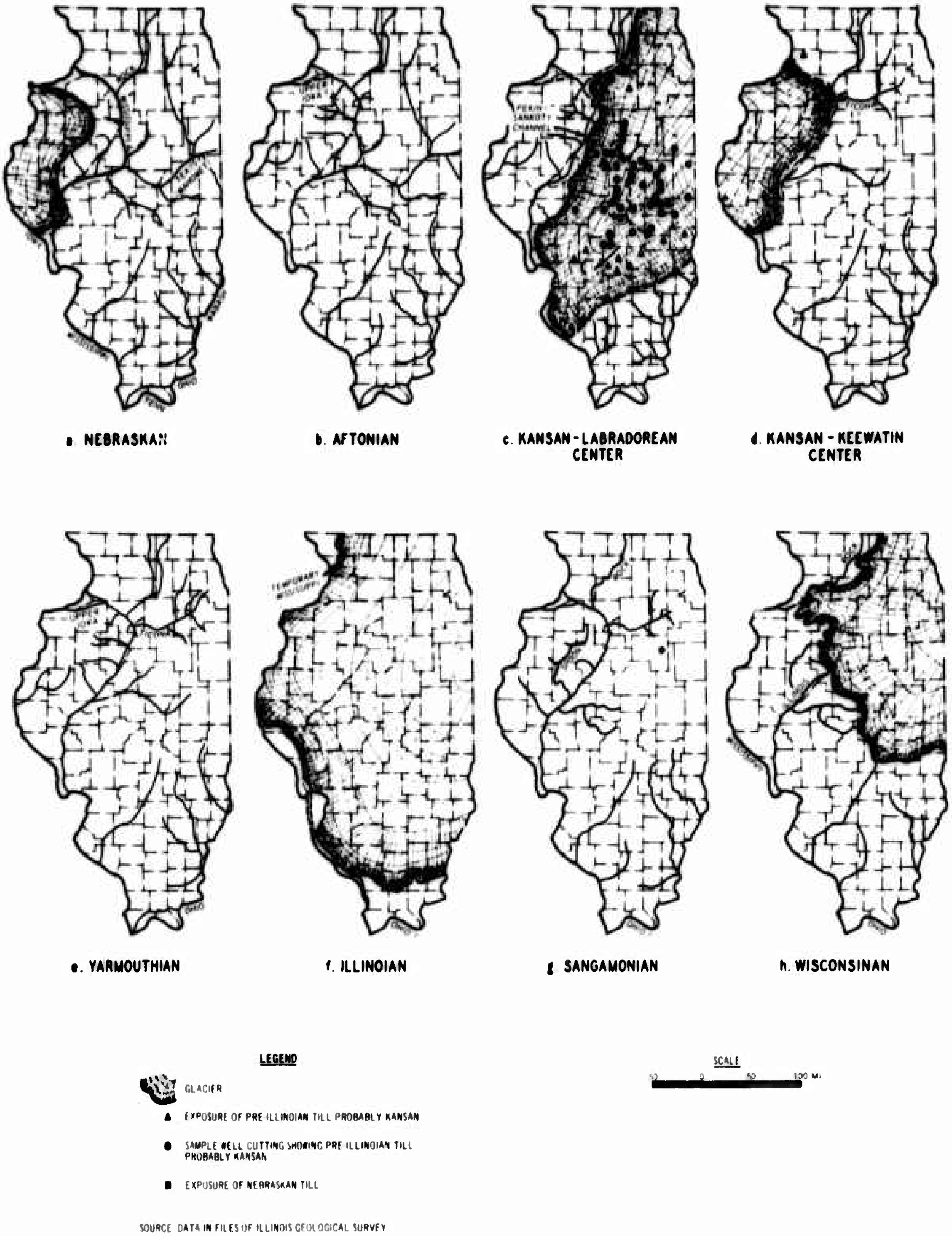

Figure 6. Drainage stages in Illinois during the glacial period

yet no evidence of important drainage changes during the succeeding Yarmouth interglacial stage.

51. Illinoian-Sangamon. With advance of the Illinoian glacier from the Labradorean center, a maximum extent of the ice in Illinois was attained and all but the three driftless areas were ice-covered.[11] During glaciation the Mississippi was pushed westward into a temporary course through glacial Lake Calvin in Iowa, but with retreat of the ice the former course through Princeton Valley was probably resumed. Ancient Rock River, however, was permanently diverted into its present course south of Rockford and the preglacial valley and its important tributary, Troy Valley, were abandoned. In the Peoria region the northern part of the Pekin-Sankoty Valley was buried and the present valley at Peoria established.

52. Important changes probably also occurred in the Pennsylvanian Upland of western Illinois: (a) the upper portions of Spoon River were diverted from their eastward and northward courses into the present valley; (b) Carthage Valley was completely buried and abandoned; (c) numerous small valleys were buried; and (d) low bedrock coals were eroded or reexcavated across the preglacial divide at several points.[11]

53. In southern Illinois the glacio-fluvial deposits of Illinoian and Wisconsin age have not been differentiated in most places, but it is likely that much of the fill in the Kaskaskia, Muddy, and Wabash basins was deposited at this time. No important drainage modifications are known to have occurred during the Sangamon interglacial stage.[11]

54. Wisconsin-Recent. Although drainage history during the final Wisconsin stage is known in detail in many areas, only two events involving the major drainage systems will be noted: (a) the Mississippi was probably diverted from its ancient course through Illinois Valley to its present channel; and (b) Ticona Valley was buried, and the present Upper Illinois River was established.[11] With retreat of the Wisconsin ice, a new generation of consequent streams developed on the newly formed till-plains. Most of these are independent of the bedrock valleys which lie deeply buried below the surface.

55. In 1908 the Board on Examination and Survey of Mississippi

River, Corps of Engineers, prepared a series of maps at a scale of approximately 1:20,000.[13] The series is in 17 sheets covering the distance from Cairo, Illinois, to St. Louis, Missouri, and contains sectional water depths, levees, bench marks, 5-ft contour intervals, roads, sandbars, cultivated and wooded areas, river lights, and borings. From 87 borings, several cross sections were prepared showing the top of bedrock (Figure 7), which indicates the depth of scouring during the formation of this reach of the Mississippi River.

Economic geology[2,14-18]

56. Illinois and Missouri receive millions of dollars annually in revenue from their economically important minerals. Some minerals are distributed throughout the states and others are confined to specific locations. Figure 8 shows the distribution of important mines, quarries, mining operations, and industrial plants in the study area. In the following paragraphs some of the more important economic resources that occur within the study area are discussed.

57. Cement. The development of the cement industry began in 1901 and has continued to prosper, with the future looking even brighter. The use of cement in modern-day construction has placed a burden upon the suppliers. However, large quantities of limestone, Mississippian and Ordovician in age, in or near the bluff line provide one of the main raw materials for cement.

58. Stone. Quarries are very active in the study area. The availability and reserve of raw material, coupled with water transportation, can result in high tonnage production of crushed stone for road surfacing, agricultural limestone, and aggregate used in concrete and bituminous roads, revetments, and related river works. Most quarries are permanent, but some contractors use portable crushers, thus using local raw material for each job. Dimension stone, including marble, accounts for only a small percentage of the total tonnage, but has a higher unit price. It is used for interior and exterior architectural building, rough construction, flagging, and rubble.

59. Clay. There is little clay available; yet it is important in the total economic development. Some of the finished products included

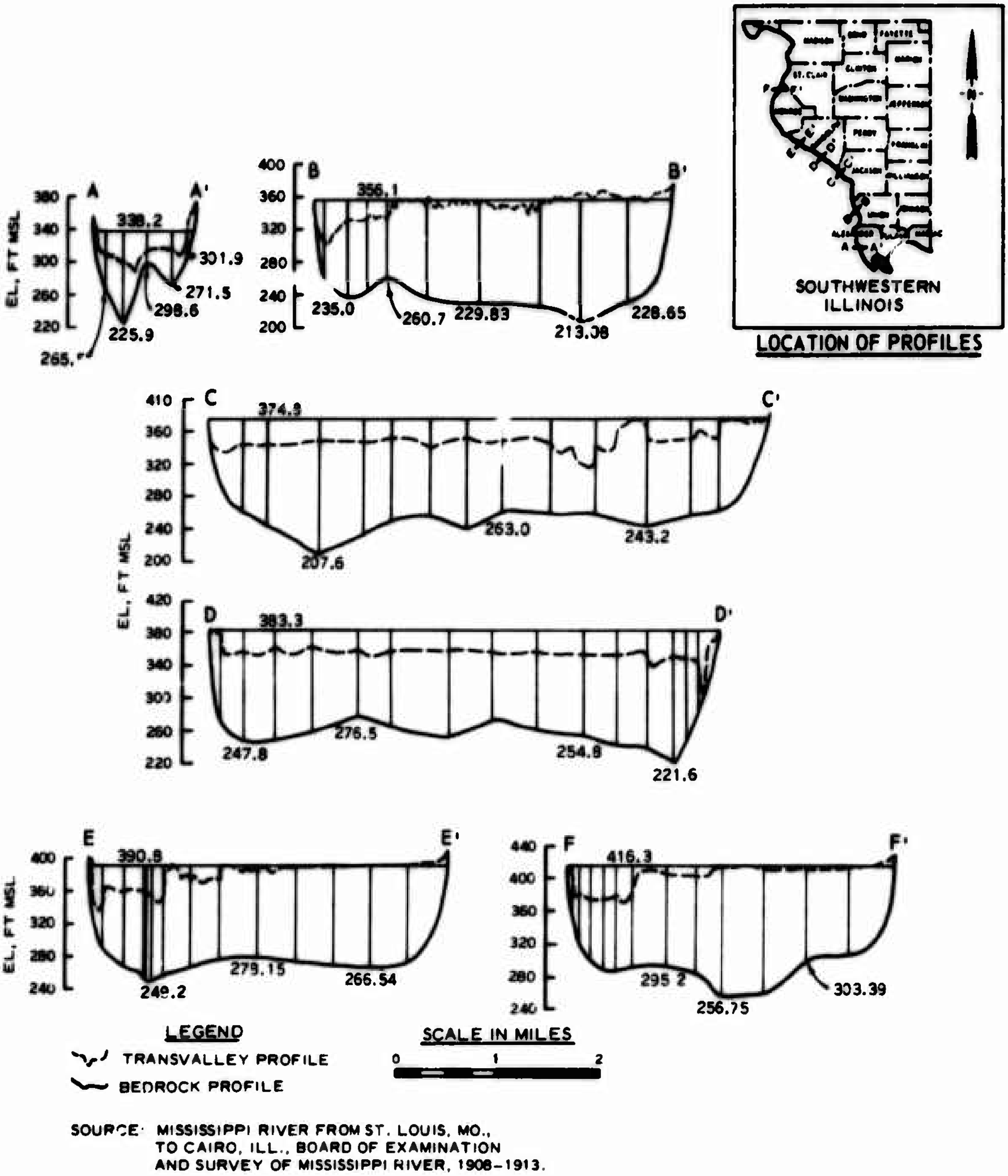

Figure 7. Bedrock and transvalley profiles along the Middle Mississippi River

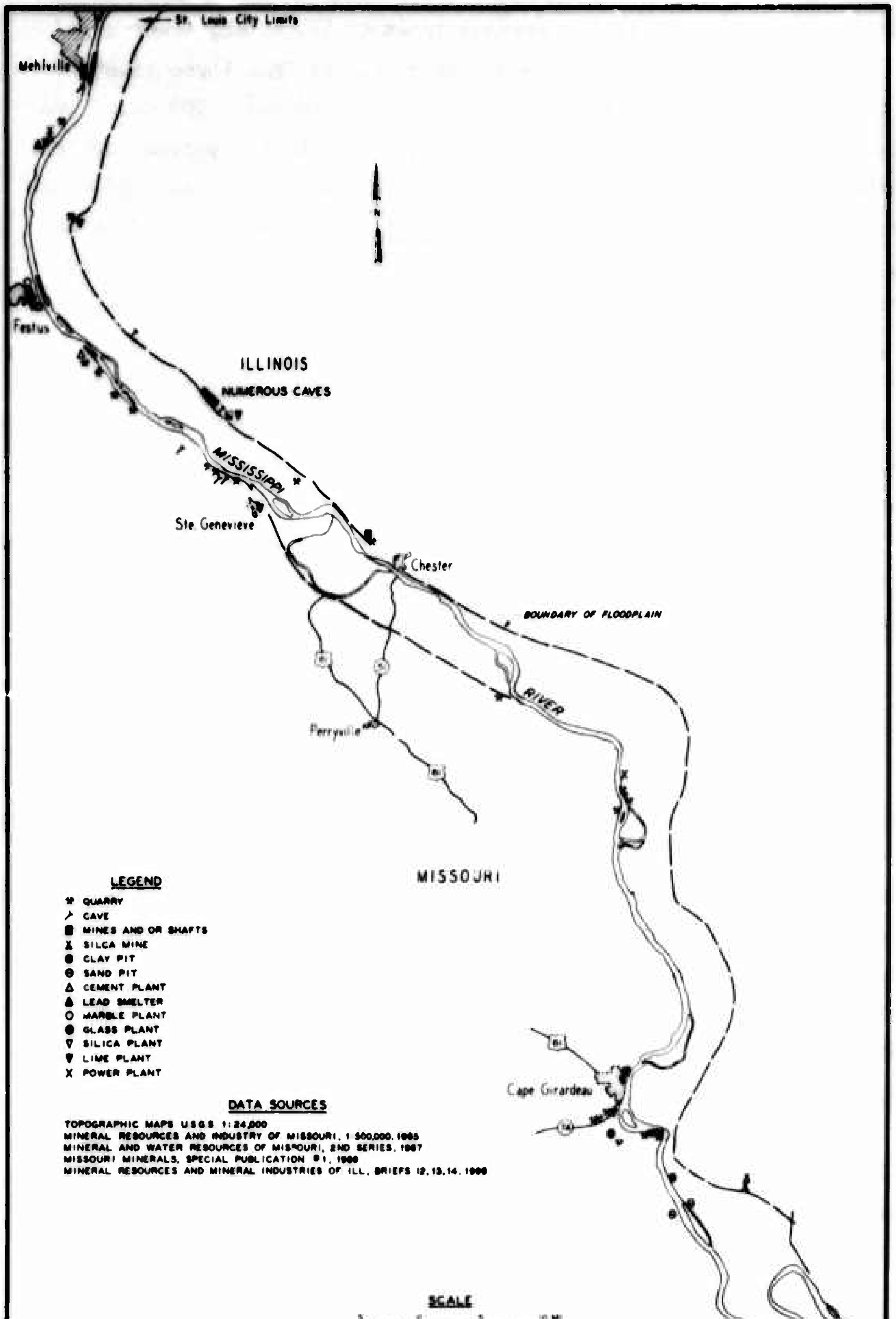

Figure 8. Economic geology of the Middle Mississippi River region

drain-tile, building block, various types of brick, and sewer pipe.

60. Silica sand. In 1968 five operators from three counties (two in Jefferson County) reported production of 1,049,000 short tons valued at $4,007,000. The Missouri output is about 5 percent of the total industrial sand production in the United States. In 1968 about two-thirds of the state's silica sand output was sold or used as unground sand for glass, grinding and polishing, blast sand, molding, filtration, and engine sand. Silica sand production is estimated to be 1,130,000 short tons in 1975 and 1,350,000 short tons in 1990.

61. Lead. A smelter is located in the Festus-Herculaneum, Missouri, area with the raw material being shipped in from outside the study area. A second smelter is located in the Wickes-Kimmswick, Missouri, area about 11 miles north of Festus, Missouri.

62. Other economic resources. Other economic resources are found in Illinois and Missouri, but are outside the study area. Some of these are barite, coal, copper, iron ore, silver, zinc, oil, and gas.

Soils

63. No comprehensive system of soil classification exists for the lands bordering the Mississippi River between St. Louis and Cairo. Much of the work in this area was done in the early part of this century prior to the development of more recent and comprehensive classification systems, and invariably reflects both a local and agricultural bias. Nevertheless, available information is discussed, by counties, in the sections that follow. Refer to map in Figure 4 for county locations within the study area.

St. Clair County, Illinois

64. The distribution of soil types within the Mississippi River floodplain is shown on the map in Figure 9.[19,20] Data on soil types delineated on the map are summarized below on a countywide basis, followed by soil type descriptions.

Figure 9. Soil survey map of St. Clair County floodplain - Illinois

Soil Type Number*	Description	Area: square miles	acres	percent of Total**
70	Beaucoup clay loam, bottom	34.45	22,000	5.17
72	Sharon loam, bottom	35.67	22,830	5.25
75	Drury fine sandy loam, bottom	18.27	11,690	2.3
92	River sand, bottom	1.69	1,080	0.24
108	Bonnie silt loam, bottom	40.15	25,700	6.02
161	Newart silt loam, bottom	6.57	4,200	0.98
162	Gorham clay loam, bottom	1.98	1,270	0.28
180	Dupo silt loam, bottom	4.48	2,870	0.66
181	Riley fine sandy loam, bottom	17.07	10,920	2.55

* "Type" is the unit of classification. The numbers are used as codes in soil survey to identify soil profiles with unique characteristics.
** Total county area = 665.7 square miles or 426.048 acres.

65. Beaucoup clay loam, first bottom (70). Beaucoup clay loam, first bottom, is found in the lower parts of the floodplains of the Mississippi and Kaskaskia Rivers and Doza Creek. It has been formed from sediment deposited from standing water, and many of the areas of this type have remained poorly drained and swampy, even though open ditches have been provided. The surface soil is a sticky, tough, brown to grayish-brown clay or clay loam 4 to 8 in. thick. There is no true subsurface and subsoil development, but the color becomes lighter with depth. The heavy plastic clay continues to depths of over 3 ft.

66. Sharon loam, first bottom (72). Sharon loam, first bottom, is found throughout the county in the bottomlands of small streams. It is subject to frequent overflow following heavy rains, and almost every overflow brings a deposit of new material. The soil is therefore young and has little or no profile development. It is a mixture of sand, silt, and clay.

67. Drury fine sandy loam, bottom (75). Drury fine sandy loam, bottom, occurs at the base of the bluffs along the eastern margins of the Mississippi River floodplain and in the adjacent small narrow creek bottoms. Parts of this type are subject to frequent overflow following heavy rains, but the water drains away quickly. The Drury fine sandy loam was derived from Recent sediment washed in from surrounding uplands, most of it having been deposited since the uplands were cleared

and farmed. It consists, for the most part, of a brownish-yellow to yellowish-gray very fine sand varying from 12 to 60 in. or more in thickness. It has not yet developed a true subsurface or subsoil.

68. River sand, bottom (92). River sand, bottom, is mapped adjacent to the bank of the Mississippi River. It is made up of rather clean sand, varying from fine to coarse, that has been recently deposited, and the type is subject to overflow whenever the channel becomes filled.

69. Bonnie silt loam, bottom (108). Bonnie silt loam, bottom, occurs as bottomland along the Kaskaskia River and its larger tributaries. The material that formed this soil is largely silt brought down from upstream and surrounding uplands. The bottomlands are nearly level, poorly drained, and often swampy. This soil has little horizon development because it is subject to frequent overflow and is continually receiving new deposits. The surface soil is a friable, gray silt loam varying from 6 to 12 in. in thickness. Below the surface the material is lighter in color, but no subsoil proper has developed.

70. Newart silt loam, bottom (161). Newart silt loam, bottom, occurs in the Mississippi River bottom on low undulating ridges. The material from which it was formed was deposited by the Mississippi River. The surface soil is a friable, grayish-brown to brown silt loam 6 to 8 in. thick. The subsurface is a brown, slightly plastic, silty clay loam, which rests on a yellow, open, sandy loam. Below 25 to 30 in. there is nearly pure sand, but the soil above has sufficient moisture-holding capacity to satisfy the need of crops in most years.

71. Gorham clay loam, bottom (162). Gorham clay loam, bottom, is found associated with gently rolling topography in the south central portion of the Mississippi River floodplain within St. Clair County. The material from which it was formed is a heavy clay loam or clay deposited by backwater on top of sand ridges, which had been previously deposited by the Mississippi River. The surface soil is a plastic, brown clay or clay loam. The color becomes somewhat lighter with depth, but the texture is unchanged. At a depth of 26 to 40 in., there is an abrupt change to nearly pure, fine sand.

72. Dupo silt loam, bottom (180). Dupo silt loam, bottom, occurs in the nearly level parts of the high bottom of the Mississippi River. The material from which the surface was formed was deposited by running water on top of a bed of clay, which had been deposited earlier by backwater. The surface soil is a friable, brown silt loam 6 to 8 in. thick. The subsurface is a grayish-brown silt loam. The subsoil, which begins at about 18 in., is a brownish, yellow-gray, slightly compact, plastic clay loam.

73. Riley fine sandy loam, bottom (181). Riley fine sandy loam, bottom, is found on Arsenal Island and gently rolling ridges in the Mississippi River floodplain. The soil material was deposited by the rapidly moving floodwaters of the Mississippi River. This soil type is naturally well drained and is either sweet or only slightly acid. Its open, porous texture and low water-holding capacity make it somewhat droughty for late summer crops such as corn. The surface is a light brown to yellowish gray. No true subsoil has developed in this type, although in places thin bands of sandy clay are found at a depth of 18 to 24 in. Normally, below about 20 in., there is a thick bed of grayish-yellow to yellow fine sand.

Monroe County, Illinois

74. The distribution of 13 soil types in the Mississippi River floodplain is shown in Figure 10.* No description of these soils was available with the soils map, but the soil type identification numbers are identical to those used in the following descriptions of the soils in Randolph County, Illinois. Descriptions for all but three of the soils listed in Figure 10 under later swamp and bottomland soils (Nos. 1413, 1421, and 1480) are provided in this report as part of the discussion pertaining to Randolph County soil types.

75. Mr. Donald C. Wallace, U. S. Department of Agriculture Soil Conservation Service, is preparing (1974) a general soil map showing distributions of soil associations and a text of detailed soil

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* The Monroe County maps used in this report originally came from a University of Illinois Agricultural Experiment Station "Soil Report," which could not be located.

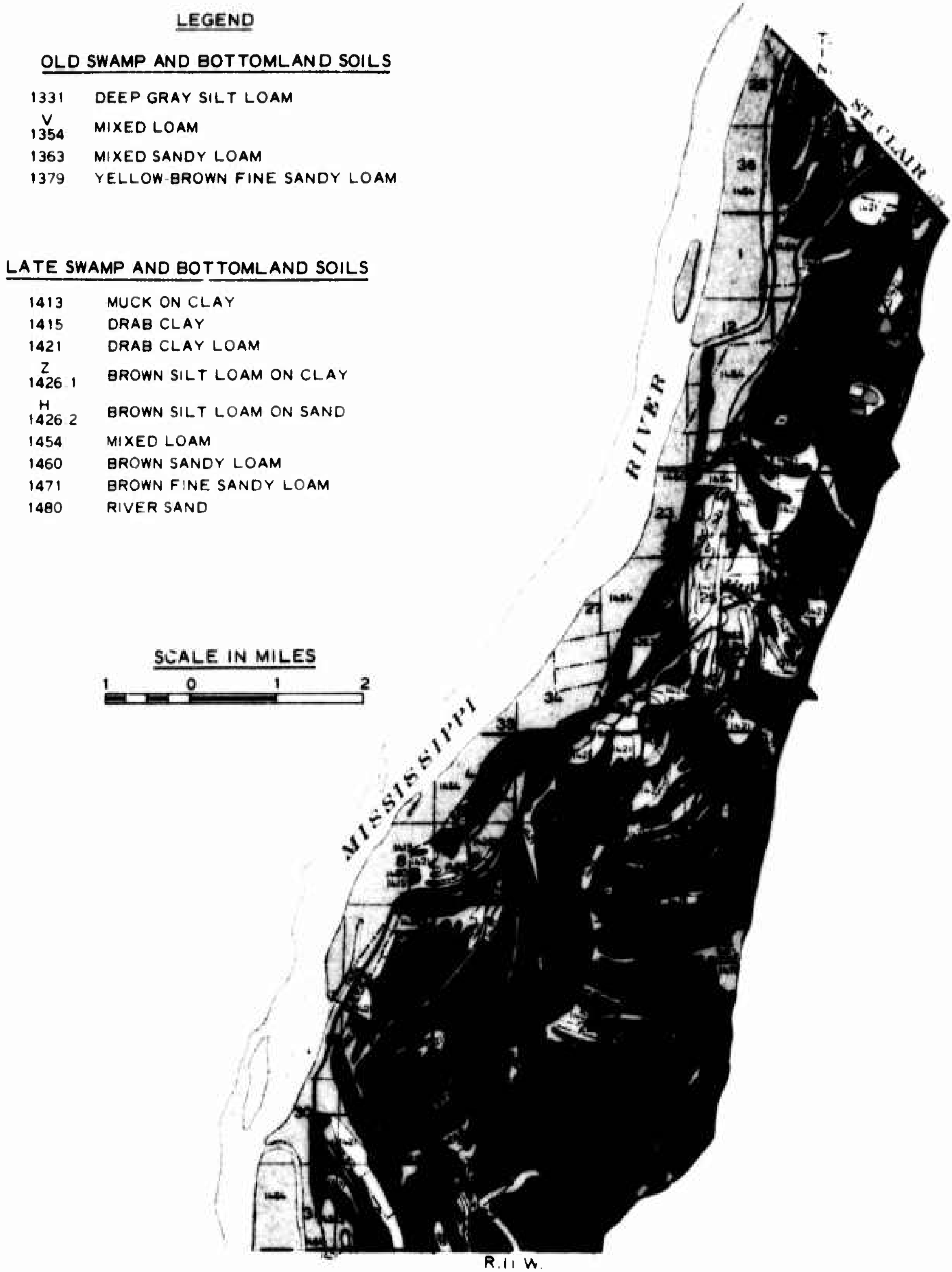

Figure 10. Soil survey map of Monroe County floodplain - Illinois (sheet 1 of 2)

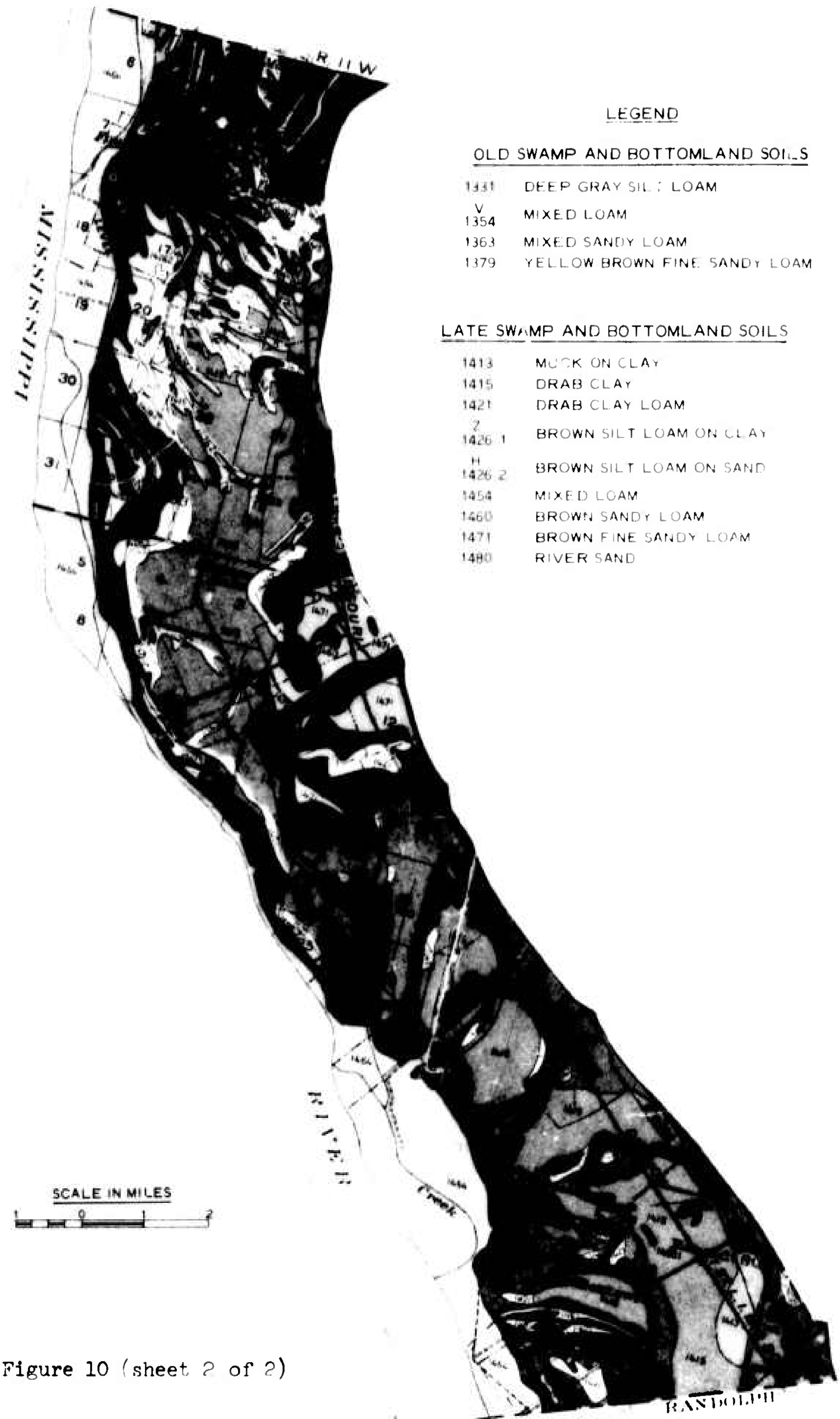

Figure 10 (sheet 2 of 2)

descriptions. Mr. Wallace's address is given in Appendix A.

Randolph County, Illinois

76. The distribution of soil types in the Mississippi River floodplain is shown on the map in Figure 11.[21] Distribution data for the soil types are summarized below on a countywide basis, followed by soil type descriptions. Reference 21 did not contain the areal extent or description for the river sand shown as soil type number 1480.

Soil Type Number	Description	Area square miles	Area acres	Area percent of Total*
1315/1415-15	Drab clay	19.93	12,755	3.36
1326	Brown silt loam	3.25	2,080	0.55
1331	Deep gray silt loam	24.44	15,642	4.29
1354-V/1454	Mixed loam	50.67	32,428	8.55
1363	Mixed sandy loam	0.44	281	0.07
1379	Yellow-brown fine sandy loam	5.19	3,322	0.87
1422.1	Brown-gray clay loam on tight clay	1.55	992	0.26
1426.1	Brown silt loam on clay	10.12	6,477	1.70
1426.2	Brown silt loam on sand	5.92	3,789	1.00
1428.1	Brown silt loam on tight clay	1.33	851	0.22
1460	Brown sandy loam	8.56	5,478	1.44
1471-71	Brown fine sandy loam	1.94	1,242	0.33
1480	River sand	--	--	--

* Total county area = 539 square miles or 344,960 acres.

77. Drab clay (1315, 1415-15). Most of the area mapped as drab clay bottom soil in Randolph County occurs in the Mississippi River bottom. This clay is dark and drab colored from the surface to a depth of about 8 in., and is drab colored below 8 in. The texture is clay throughout the soil section, and dark, reddish-yellow splotches begin to occur at a depth of about 6 in.

78. Brown silt loam (1326). Brown silt loam, bottom, is found along the Kaskaskia River. It is a Recent soil, as shown by the absence of horizon development. The surface to a depth of about 12 in. is brown silt loam. At this depth the color changes to drabbish brown with slight mottling.

79. Deep gray silt loam (1331). Deep gray silt loam, bottom, comprises the major portion of the small bottoms throughout the county.

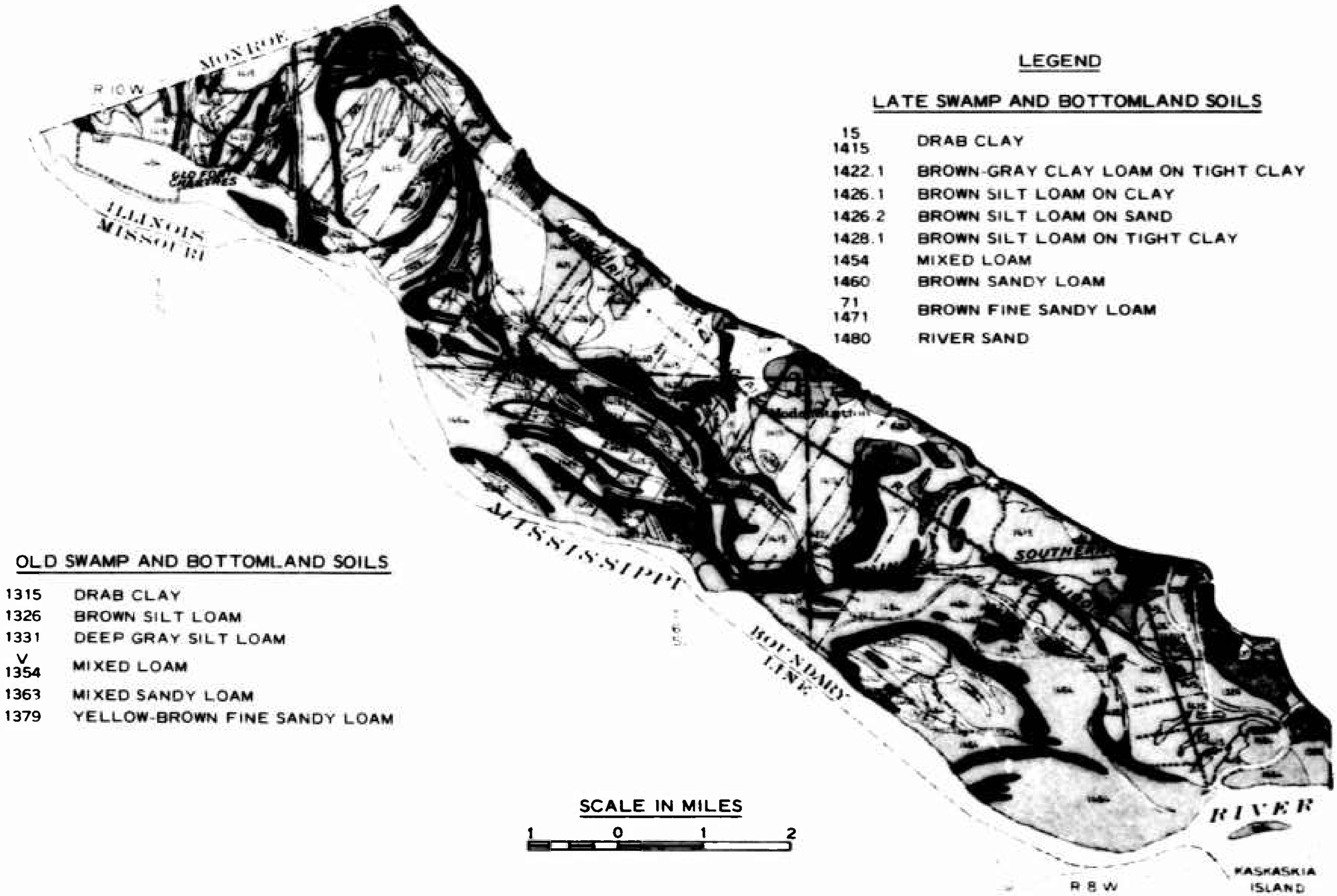

Figure 11. Soil survey map of Randolph County floodplain - Illinois (sheet 1 of 2)

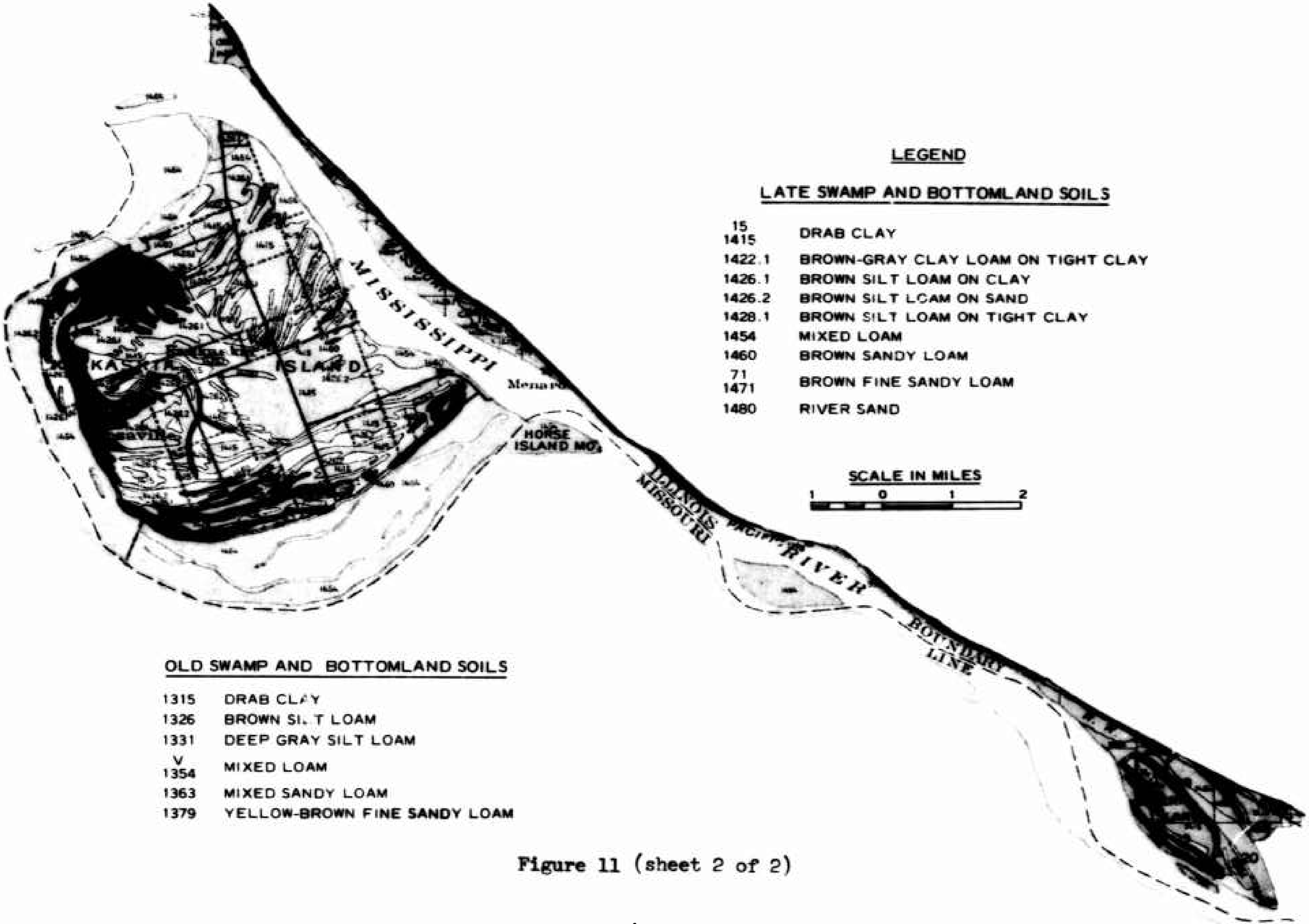

Figure 11 (sheet 2 of 2)

The surface soil is about 7-in.-deep and is a light brownish-gray silt loam. Distinct subsurface and subsoil horizons are not usually found to have been developed. Over a considerable portion of the type, a gray, fine, sandy silt loam subsurface is found extending to a depth of about 30 in., and then a strongly mottled, chocolate-colored, fine, sandy silt loam subsoil, which is not plastic and only slightly compact, occurs.

80. Mixed loam (1354-V, 1454). Mixed loam is found in the bottoms along the upper courses of the small streams throughout the county and in the Mississippi River bottom. Much of this land is subject to frequent flooding and, while it is productive, it must be used for crops that can be planted and harvested between flood periods. Much of this type is occupied by timber. The timber growth consists of sycamore, maple, elm, hickory, oak, and other varieties. The areas classified as mixed loam consist of a variety of soils, which cannot successfully be separated. Some of this land is under cultivation and much of it would be well adapted to general farming were it not for frequent flooding.

81. Mixed sandy loam (1363). Mixed sandy loam is similar to mixed loam, except that its texture is coarser.

82. Yellow-brown fine sandy loam (1379). Yellow-brown fine sandy loam, bottom, consists of a deposit of wash derived from the adjacent bluffs, and it varies considerably in depth. The underlying soil upon which it has been deposited is frequently encountered within a depth of 40 in. below the surface. The deposit is so recent that slight horizon development has taken place. The surface to a depth of 9 or 10 in. is yellowish-brown, fine sandy loam; below this, down to the underlying soil upon which the deposit has been made, it is grayish yellow and of the same texture as the surface soil.

83. Brown-gray clay loam on tight clay (1422.1). Brown-gray clay loam on tight clay occurs in relatively small areas in the Mississippi River bottom south of Modoc Station. The surface soil is a brown clay and is about 8 in. deep. The subsurface in places is drab clay, which extends without change to 40 in. or more in depth. In other places there is a grayish drab clay stratum to a depth of about 14 in., and then a highly plastic drab clay to 40 in. or more in depth.

84. <u>Brown silt loam on clay (1426.1).</u> Brown silt loam on clay, bottom, is a productive soil, though inadequately drained. The surface soil, which is usually about 9 in. deep, is brown silt loam. In some portions of the area, the subsurface, 9 to 18 in., is grayish-brown silt loam, while in others this stratum is black clay that rests on drab clay at a depth of about 18 or 19 in. Where the grayish-brown stratum is present, it usually rests on a thin stratum of black clay, and the drab clay occurs at a depth of about 26 in. instead of at 18 or 19 in.

85. <u>Brown silt loam on sand (1426.2).</u> Brown silt loam on sand occurs mainly on Kaskaskia Island. Its peculiar formation in long narrow strips between depressions of drab clay or brown sandy loam is due to river action. The depth to sand varies from 5 or 6 in. to about 30 in. The surface soil is brown silt loam and is about 8 in. deep, where the sand does not occur within that distance below the surface. Below the surface soil down to the sand is a drabbish brown silt loam.

86. <u>Brown silt loam on tight clay (1428.1).</u> Brown silt loam on tight clay occurs in small areas in the Mississippi River bottom between Fort Gage and Prairie du Rocher. The surface soil, which is about 7 in. deep, is brown silt loam. The subsurface soil, usually a thin stratum of only 3 or 4 in. in thickness, is grayish-brown, silty clay loam. The upper subsoil, which extends to a depth of about 28 or 30 in., is a mottled, brown-and-yellow clay loam, fairly compact and plastic. The lower subsoil is a very friable, mottled, yellow sandy silt loam.

87. <u>Brown sandy loam (1460).</u> Brown sandy loam, bottom, occurs, for the most part, as long narrow ridges of sandbar-like formation located in the Mississippi River bottom and on Kaskaskia Island. It varies from a good productive sandy loam to coarse sand. Much of it, however, is good soil, but the danger of frequent flooding lessens its agricultural value, particularly on the southern side of Kaskaskia Island and just west of the mouth of the Kaskaskia River.

88. <u>Brown fine sandy loam (1471-71).</u> Brown fine sandy loam, bottom, is similar in origin to yellow-brown fine sandy loam, but is an older formation, as is shown by the development of fairly distinct strata or horizons. The surface soil is about 10 in. deep and is a brown

sandy loam. The subsurface extends to a depth of about 20 in. and is a grayish-brown, fine sandy loam. The subsoil to the depth sampled (40 in.) is a brownish-gray, fine, sandy loam.

Jackson County, Illinois

89. The distribution of soil types in the Mississippi River floodplain of Jackson County, Illinois, is shown on the map in Figure 12.* Descriptions of soil types identified in Figure 12 were not available.

Union County, Illinois

90. The distribution of soil types in the Mississippi River floodplain of Union County, Illinois, is shown on the map in Figure 13.** Descriptions of the soil types identified in Figure 13 were not available.

Alexander County, Illinois

91. The distribution of soil associations in the Mississippi River floodplain in Alexander County are shown in Figure 14.[22] The soil associations included in the legend are only those that occur on the map and do not represent all soil types occurring in Alexander County. Soil association descriptions are given in the following paragraphs.

92. Alford-Stookey-Muren Association. This association is characterized by moderately to strongly sloping ridgetops and steep side slopes. It occurs principally in the vicinity of Thebes in Alexander County. A gently to strongly rolling area is west of Olive Branch. In most places the soils formed in depressions in loess that is between 20 and 30 ft thick over Coastal Plain gravel. In other places the loess is underlain by chert bedrock. The ridgetops, which are from 100 to 400 ft in width, commonly are cultivated.

93. Crop fields are confined to ridges and bottomlands, and thus most are narrow and small. Wooded areas are large. Pastures vary in size.

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* Obtained from soil association map, dated 1961, of Jackson County, source unknown.

** Obtained from soil association map, undated, of Union County, source unknown.

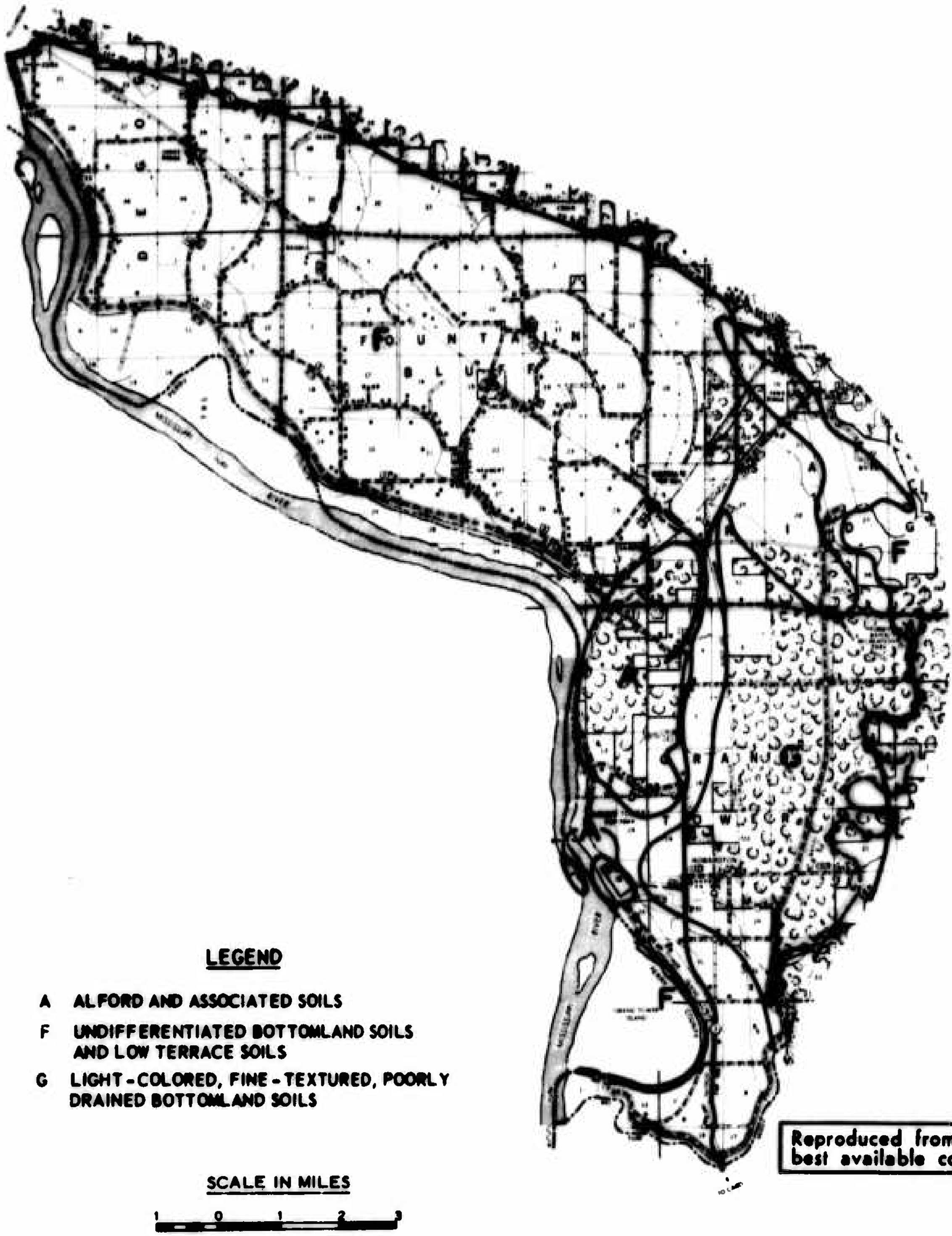


Figure 12. Soil association map of Jackson County floodplain - Illinois

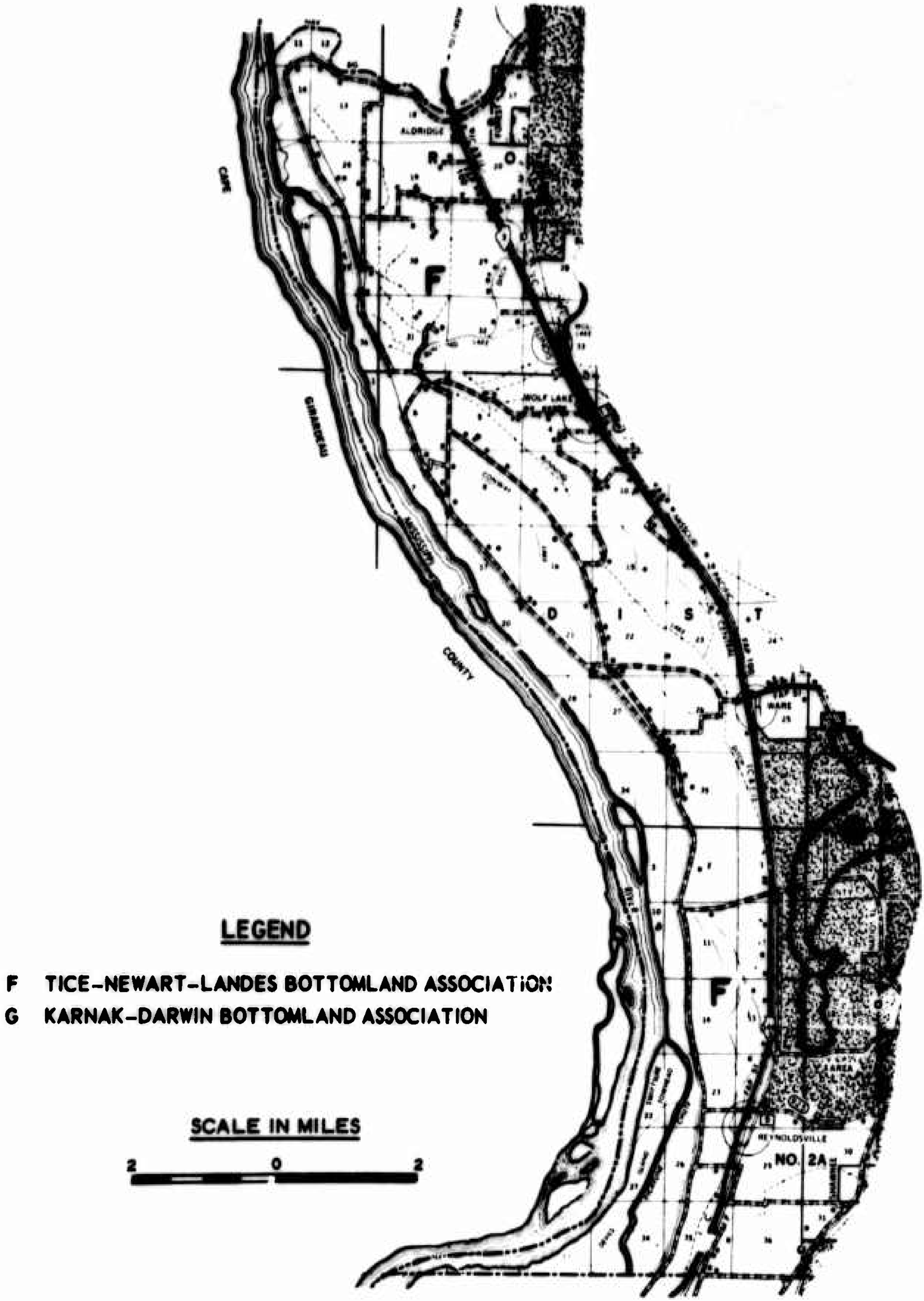


Figure 13. Soil association map of Union County floodplain - Illinois

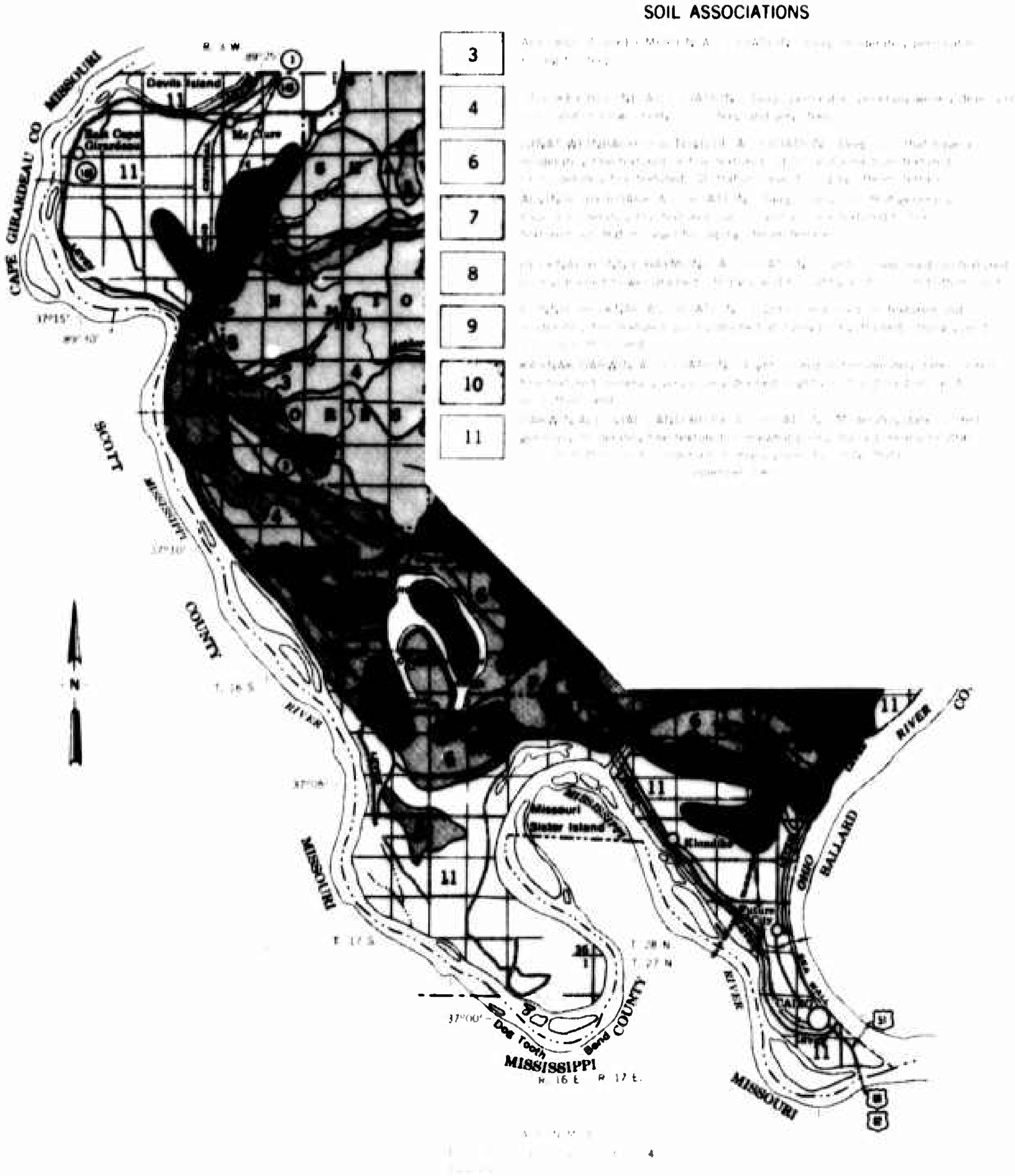


Figure 14. Soil association map of Alexander County floodplain - Illinois

94. Erosion is the major hazard if the soils of this association are used for crops. If the full potential of these fairly productive soils is to be realized, measures must be taken to maintain fertility and to improve the management of pastures and woodland.

95. Stookey-Bodine Association. The topography of this association is distinctive. The elevations vary as much as 300 ft within a horizontal distance of 600 ft. Slopes are steep or very steep; ridgetops are long and generally extremely narrow; and the drainage pattern is intricate, highly developed, and deeply incised. The rugged hills are capped by a mantle of loess that ranges from 20 to 30 ft or more in thickness and generally overlies massive beds of chert. This association covers all of the uplands of Alexander County, except for some small areas of the Alford-Stookey-Muren Association.

96. Other minor soils in the Stookey-Bodine Association include Hosmer soils, which contain a fragipan, and are on foot slopes or slopes along the north and west sides of many valleys. Small to medium-size areas of bottomlands along creeks are occupied mainly by the well-drained Haymond soils, the somewhat poorly drained Wakeland soils, and the poorly drained Birds soils. The well-drained or moderately well-drained Elsah soils, which are cherty, are also on bottomlands.

97. The bottomlands and foot slopes are used mainly for crops and pasture. A few ridges are wide enough to be used for crops, but most ridges are too narrow or are not readily accessible. Hillsides are used occasionally for pasture. Most of the acreage is wooded. About two-thirds of the acreage in this association is in the Shawnee National Forest. Timber is the principal product. Steepness and stoniness are the major limitations in the use of the soils for crops or pasture. Erosion must be controlled if the slopping soils are used for crops or pasture, and flash floods are a hazard on bottomlands.

98. Ginat-Weinback-Sciotoville Association. This association consists of low stream terraces closely intermingled with long narrow bottomlands. It occurs principally along the Cache River and another area around Horseshoe Lake. The difference in elevation between the terraces and the bottomlands varies. In some places it is as little as

2 ft, and the terraces are difficult to distinguish from the bottomlands. In other places the difference is 10 ft or more. In width the terraces range from less than 100 to more than 1000 ft. They generally are level or gently sloping, but some short strong slopes occur either where the terraces join the bottomlands or along drainageways. The terraces were derived from alluvial material laid down by the Ohio River during glacial periods. In places the alluvial material is covered with a small accumulation of loess.

99. On terraces south and west of Horseshoe Lake are three dark-colored soils: somewhat poorly drained Millbrook and moderately well-drained Harvard soils, both of which have a silt loam surface layer, and well-drained Disco soil, which has a fine sandy loam surface layer.

100. Interlaced throughout the terraces, on bottomlands along narrow drainageways and stream channels, are the poorly drained Karnak and Bonnie soils. The Karnak soils have a silty clay loam or silty clay surface layer, and the Bonnie soils have a silt loam surface layer. These two soils make up about 23 percent of the association.

101. Nearly half of this association is used for crops, principally corn, soybeans, and wheat. Nearly a third is wooded. The rest is used for permanent pasture. Much of the woodland is along streams and drainageways. Some cotton is grown, but the soils as a whole are not well suited to cotton.

102. Drainage is necessary on the poorly drained Ginat, Okaw, and Racoon soils and on the somewhat poorly drained Weinbach, Hurst, and Millbrook soils. Overflow is a hazard on the Karnak and Bonnie soils. Erosion is a problem on all of the sloping soils, but control of erosion is not difficult because most slopes are gentle or short. Nearly all of the soils are strongly acid and are low in natural fertility.

103. Alvin-Roby-Ruark Association. This association consists principally of terraces in the lower half of the Cache River valley, near Unity, Olive Branch, and Horseshoe Lake. In many places the terraces are not more than 2 ft above the surrounding bottomlands; in other places they are as much as 10 ft. Most of the terraces are gently or moderately sloping; some are level or nearly level; and a few are

strongly sloping, particularly where they adjoin bottomlands. The soils on terraces were derived chiefly from alluvial material laid down by the Ohio River during glacial periods. They generally have a fine sandy loam surface layer and in most places a stratified sandy, silty, and clayey substratum.

104. The somewhat poorly drained Belknap soils, the poorly drained Bonnie soils, and the very poorly drained Karnak soils are chiefly on bottomlands.

105. Most of this association is used for crops, principally corn, soybeans, wheat, cotton, and rotation pasture. Little of the acreage is used for permanent pasture, and generally only the very poorly drained soils on bottomlands have remained wooded.

106. Most of the soils need additions of organic matter to help improve tilth, alleviate droughtiness, and control wind erosion. The hazard of wind erosion is especially serious on the Bloomfield soils, which should be protected by growing crops as much of the year as possible. Surface drainage generally is necessary on the Ruark soils and in places on the Roby soils. Water erosion is only a slight hazard on the porous soils of this association.

107. Belknap-Bonnie-Haymond Association. This association consists of scattered areas of converging bottomlands that range from a 1/4 to 1 mile in width.

108. The Belknap soils make up about 38 percent of the association, the Bonnie soils about 30 percent, and the Haymond soils about 20 percent. The somewhat poorly drained Belknap soils and the poorly drained Bonnie soils generally are strongly acid. The well-drained Haymond soils generally are slightly acid. They are closely associated with soils of the Alford-Stookey-Muren and the Stookey-Bodine Associations.

109. About 12 percent of this association consists of the somewhat poorly drained Wakeland soils, the poorly drained Birds soils, and the moderately well-drained to well-drained Elsah soils. The Wakeland and Birds soils generally are slightly acid, and the Elsah soils have chert mixed with the soil material.

110. Most of this association is used for crops, although the Bonnie soils are also used about equally for pasture and woodland, and the other soils are used to some extent for pasture.

111. Protection from overflow is the most common problem on these soils. Floodwaters do not remain for long periods, but flash floods can cause scouring and deposition of silt and debris. The poorly drained Bonnie and Birds soils generally need surface drainage, and some areas of the somewhat poorly drained Belknap and Wakeland soils are benefited by drainage. Surface crusting and poor tilth are common on the Bonnie and Birds soils. Erosion is not a hazard on these level and nearly level soils.

112. Bonnie-Belknap Association. This association consists of bottomlands, principally along the Cache River, and areas that were once the floodplain of the ancient Ohio River. The soils are wet, light colored, and generally low in fertility. Near the Cache River, they are subject to recurring overflow, and they may be flooded for several days or for weeks at a time. Some areas are too wet for the production of cultivated crops.

113. Areas that are very wet or that are frequently flooded have remained wooded. Other areas are used for corn. soybeans, wheat, and some cotton. Little of this association is used for permanent pasture.

114. The soils that are not subject to overflow are moderately productive if they are adequately drained, limed, and fertilized. Additions of organic matter are necessary to alleviate surface crusting of the Bonnie soils and to improve the tilth of the Karnak, Piopolis, and Petrolia soils. The soils along the Cache River are used only for woodland because protection from overflow is not economically feasible.

115. Karnak-Darwin Association. This association consists of low areas in the Cache River Valley and of bottomlands along the Mississippi River between Gale and McClure. The soils formed in fine-textured, lake-laid, or slack-water sediments, and they generally are fertile and only slightly acid. They are limited in use, however, because of wetness and poor tilth.

116. The major problems in this association are removal of excess

water, maintenance of fertility, and improvement of tilth. Overflow is a hazard only in sloughs and in areas adjacent to the Cache River.

117. Darwin-Alluvial Land-Riley Association. This association includes most of the bottomlands along the Mississippi River and bottomlands along the Ohio River in the vicinity of Cairo. Along the Mississippi River, the bottomlands are level to undulating and are dissected in many places by remnants of bayous, sloughs, and stream channels. There are also many old natural levees. The soils in the vicinity of Dogtooth Bend and Sister Island are not protected and thus are subject to overflow by the Mississippi River. In Alexander County the area occupied by this association is in the Mississippi River floodplain.

118. No one soil is dominant in this association. The soils, in order of decreasing acreage, are Darwin, Alluvial Land, Riley, Landes, Ware, Cairo, Tice, Gorham, Newart, Beaucoup, Bowdre, Dupo, Allison, and Sarpy. These soils range from well-drained to very poorly drained and from loamy fine sand to silty clay. They generally have very sandy strata either at the surface or at depths ranging to more than 5 ft. The soils are predominantly dark colored and generally are highly productive. They are slightly acid to mildly alkaline and are highly fertile.

119. Soybeans and corn are the principal crops in this association, but some wheat and cotton are also grown. For many years alfalfa was the important crop in the vicinity of McClure. Little of the land is used for permanent pasture; but some is used for rotation pasture for livestock. Only the areas that are very poorly drained and those that are subject to frequent overflow are wooded.

120. Drainage is necessary in some areas of the poorly drained Darwin, Beaucoup, and Cairo soils and also in places on the somewhat poorly drained Tice, Gorham, Newart, Dupo, and Bowdre soils. Maintenance of good tilth is a problem on the Darwin, Cairo, and Bowdre soils because their surface layer is silty clay. It may also be a problem on the Tice, Gorham, Riley, and Beaucoup soils, which have a silty clay loam surface layer. Additions or organic matter are necessary on the Landes and Sarpy soils. The Sarpy soils also have been protected from

wind erosion. Alluvial Land areas are subject to frequent overflow and generally are left wooded.

St. Louis County, Missouri

121. No significant amount of the Mississippi River floodplain occurs in the study area in St. Louis County. A soil survey map and soil descriptions for St. Louis County are available in Reference 23.

Jefferson County, Missouri

122. The Mississippi River floodplain area occurring in Jefferson County is minimal. Attempts were made to obtain information or published references on Jefferson County soils, but none were located.

Ste. Genevieve County, Missouri

123. Only a very small Mississippi River floodplain area occurs at the eastern edge of Ste. Genevieve County. No information or published references could be obtained for soil types occurring in this county.

Perry County, Missouri

124. A relatively small part of northeastern Perry County is in the Mississippi River floodplain, a soil survey map of which is shown in Figure 15.[24] All soils occurring in the county are included on the map, although not all of these occur in the floodplain. Distribution data for nine of these soils, delineated on the map in Figure 15, are summarized below on a countywide basis, followed by soil series and type descriptions.

Soil Type Identification	Name of Type	Area: square miles	Area: acres	Area: percent of Total*
Sc	Sarpy clay	9.90	6336	2.1
Sf	Sarpy fine sandy loam	4.80	3072	1.8
Sl	Sarpy loam	8.30	5312	1.8
Ss	Sarpy silty clay loam	0.70	448	0.2
Sk	Sharkey clay	6.60	4224	1.4
Sv	Sarpy very fine sandy loam	5.50	3520	1.2
V	Vicksburg silt loam	2.70	1728	0.6
Wc	Wabash clay	6.80	4352	1.4
Ws	Wabash silty clay loam	0.90	576	0.2

* Total county area = 480 square miles or 307,200 acres.

LEGEND

Cg–CLARKSVILLE GRAVELLY LOAM
Cl–CLARKSVILLE STONY LOAM
Hc–HAGERSTOWN SILTY CLAY LOAM
Hg–HUNTINGTON GRAVELLY LOAM
Hl–HUNTINGTON LOAM
Hs–HUNTINGTON SILT LOAM
Hsl–HAGERSTOWN SILT LOAM
Kl–KNOX SILT LOAM
Js–JUDSON SILT LOAM
R–ROBERTSVILLE SILT LOAM
Sc–SARPY CLAY
Sf–SARPY FINE SANDY LOAM
Sk–SHARKEY CLAY
Sl–SARPY LOAM
Ss–SARPY SILTY CLAY LOAM
Sv–SARPY VERY FINE SANDY LOAM
Tl–TILSIT SILT LOAM
V–VICKSBURG SILT LOAM
Wc–WABASH CLAY
Ws–WABASH SILTY CLAY LOAM

Figure 15. Soil survey map of Perry County flood plain - Missouri

125. <u>Sarpy series.</u> The soils of the Sarpy series range from light gray to brownish gray in color. The subsoils are gray to yellow. They differ from the Wabash in having loose silty or fine sandy subsoils, distinctly lighter in texture than those of surface soils. This series has developed in the bottoms of the Mississippi and Missouri Rivers and their larger tributaries. The material is alluvial in origin. Because of their low position, these soils are subject to overflow, although between the flooded stages of the streams, the nature of the soil and subsoil is such that drainage is thorough to excessive. In general, the topography is flat. The Sarpy clay, fine sandy loam, loam, silty clay loam, and very fine sandy loam are recognized in Perry County.

126. Sarpy clay (Sc) is a dark-brown clay that grades into lighter-brown clay at about 6 to 8 in. Between depths of about 8 and 30 in. lighter textured, yellowish, friable material is encountered. This varies from silty clay loam in the upper part to fine sandy loam, very fine sandy loam, fine sand, or very fine sand in the lower part of the 3-ft layer. The lighter deep subsoil has the effect of giving the soil thorough drainage. This soil is alluvial in origin. It occurs in the Mississippi river bottoms. It is used mainly for wheat and corn, and excellent yields of both crops are obtained. Wheat produces maximum yields of 40 bushels per acre. Where well-drained this type is well suited to alfalfa.

127. Sarpy fine sandy loam (Sf) is a light-brown fine sandy loam, underlain at about 3 to 6 in. by a grayish, loose, fine to very fine sand, which extends beyond a depth of 3 ft. In some places the subsoil contains thin layers of soil of different texture. This is an alluvial type developed along the Mississippi River. It is still in process of formation along the river by addition of deposits from overflow. The Sarpy fine sandy loam is not very extensive in this county. The soil is well drained and easily cultivated, and is very productive where the supply of organic matter is maintained. Excellent yields of corn and wheat are obtained and the type is well adapted to alfalfa. It is an excellent soil for truck farms, but is not used extensively for this purpose because of the remoteness of large markets. Yields of 80 to

170 bushels per acre of corn are frequently obtained on this type.

128. Sarpy loam (Sl) is a brown or dark-brown loam underlain at depths of about 6 to 18 in. by a yellow or yellowish-brown fine or very fine sand, or somewhat heavier material of the same general character. In places the texture varies from fine sandy loam to silt loam or silty clay loam, such variations being too irregular in occurrence or too small in extent to be indicated on the soil map. This type occurs in the higher, better drained areas of the bottoms, occupying the swells, hummocks, and relatively high flats. Usually the surface is not level, but is more or less hummocky or billowy. The Sarpy loam is a somewhat better soil than the Sarpy clay; i.e., its lighter surface texture gives it better aeration and penetration of warmth and makes it easier to till. The type is ideally adapted to wheat, corn, and alfalfa. These crops are grown extensively and produce excellent yields. Yields of 40 bushels per acre of wheat are sometimes reported, but the average yield is probably between 20 and 25 bushels per acre. All of this type is in cultivation.

129. Sarpy silty clay loam (Ss) consists of a rather dark-brown, friable silty clay loam, underlain at about 5 or 6 in. by yellowish-brown silty clay loam, which grades below into yellow or yellowish-brown fine sandy loam or very fine sandy loam. In places there is a layer of silty clay over the lighter textured lower subsoil material. The type is not very extensive. It is a Mississippi River bottom soil, separated from the river by the Sarpy fine sandy loam. The surface is smooth. The type is well drained and produces excellent yields of all crops common to the region.

130. Sarpy very fine sandy loam (Sv) is developed as a narrow strip along the Mississippi River from near Allens Landing to the Ste. Genevieve County line. It consists of a light-brown to grayish-brown very fine sandy loam, which passes below into a loose very fine sand. All of the type is in cultivation. Corn and alfalfa are grown extensively, and both crops produce large yields.

131. Sharkey series. The Sharkey soils are yellowish brown to drab, with mottled rusty-brown, bluish, drab, and yellowish subsoils of

plastic structure. In the slight depressions where water stands for a large part of the year, organic-matter accumulations impart a nearly black color to the soil. The series contains a high percentage of clay in both soil and subsoil. These soils occur as bottomlands subject to overflow from the Mississippi River. The component material was mainly deposited some distance back from the river by quiet water. On drying they give the rise to the local name, "buckshot." These soils are poorly drained and subject to annual overflow. Only one member of the Sharkey series, the clay, is recognized in Perry County.

132. Sharkey clay (Sk) typically consists of a mottled rusty-brown, dark-drab, heavy plastic clay, passing below into blue, sticky clay frequently mottled with yellowish brown. The soil cracks on drying. Near the foot of the upland slopes, there is in places an overwash of brown silt loam. The Sharkey clay occupies depressed areas in Mississippi River bottoms. It is a lower lying soil than the Wabash. Until drained by a recently constructed canal, this type comprised swampland, which was frequently covered with water. The forest growth consists of hackberry, ash, pecan, willow, sweet gum, shellbark hickory, sycamore, and water oak. This soil is representative of the buckshot land typically developed in the Mississippi River bottoms to the south. This type has been developed by accumulations of silt and clay in areas where water has stood for a considerable length of time, allowing the finer particles carried in suspension to settle. The surface soil in places has been modified by the accumulation of organic matter. Most of the type represents an old channel of the river, which has gradually been filled by soil material during time of flood. The greater part of this type is in need of drainage. Only a small part of the area covered with Sharkey clay soil is not in cultivation, and excellent yields of corn are obtained where it is cultivated. It is doubtful whether large yields can be produced in seasons of normal rainfall unless adequate drainage is provided. With proper drainage Sharkey clay ranks among the best of the bottom soil types. The difficulty of cultivation, however, makes this type, like the heavy Wabash soils, somewhat less desirable for farming than those of lighter texture.

133. <u>Vicksburg series.</u> The soils of the Vicksburg series are brownish and prevailingly silty; the subsoils are brown or dark brown and have a friable structure. the material represents alluvial deposits derived from brown loess or such soils as the Memphis and the Knox. Along some of the smaller streams, much of the material is of colluvial character or partly colluvial, having been moved only a short distance from the adjacent slopes and lateral drainageways; but the typical soils occur as first-bottom, frequently overflowed alluvium. Along some streams inundation is not always from the central or main stream channels, but from the smaller tributaries. In Perry County only one type of the Vicksburg series is mapped, Vicksburg silt loam.

134. Vicksburg silt loam (V) consists of a brown, mellow silt loam, which changes little with increase in depth, except that grayish, rusty-brown mottling is sometimes encountered in the lower subsoil. The type occurs along the outer edge of the Mississippi River bottoms at the foot of the uplands, near streams issuing from the Knox silt loam. It consists mainly of material washed from the Knox silt loam. The type also includes small, unimportant areas in which the subsoils resemble those of the Wabash soils. The Vicksburg silt loam is well drained and is easily cultivated. Corn is the principal crop, and yields of 75 bushels per acre are frequently obtained. This soil is also well suited to small grains and alfalfa. All of the Vicksburg silt loam is in cultivation, but because of its limited distribution in the county, it is a comparatively unimportant type.

135. <u>Wabash series.</u> The Wabash soils are prevailing black ranging to dark brown, and contain a high percentage of organic matter. The subsoils are drab or gray. These soils were developed in the first bottoms of streams in the central prairie states. They extend for long distances along the Mississippi River. The material is derived mainly from the calcareous drift material and loessial deposits of the Mississippi River basin. The Wabash series is represented in Perry County by two types, clay and silty clay loam.

136. The surface soil of the Wabash clay (Wc) is a dark-brown to nearly black clay, which has a crumbly structure when dry. It is

underlain at about 6 in. by a plastic clay, which becomes lighter brown with increase in depth. In places at about 30 to 36 in. the subsoil is mottled, yellowish brown and ocherous yellow or drab. The material below 4 or 5 ft is usually sandy. This type occupies flat areas in the Mississippi River bottoms. In places it is rather poorly drained. The heavy clay surface material makes it difficult to pulverize. The type is locally known as "gumbo." The incorporation of organic matter improves the physical structure of the soil, giving it better tilth. The Wabash clay is very rich in plant food constituents, and produces large yields of wheat, corn, oats, and grass. It is a particularly good wheat soil. Clover does well on the better drained areas. Practically all of the type is in cultivation.

137. Wabash silty clay loam (Ws) occupies flat areas in the Mississippi River bottoms bordering the Wabash clay. It is on higher elevations than the clay type and is consequently somewhat better drained. The surface soil is a dark-brown silty clay loam, which grades at about 15 to 18 in. into a brown, heavy silty clay loam to clay. The lower substratum is mottled with yellow and drab. Like the Wabash clay, this soil puddles if disturbed when wet, and forms clods on drying. It is therefore difficult to work, expecially during seasons of heavy rainfall. This soil is naturally productive, but in places it is in need of drainage, which is probably best effected by the use of tile, because of the flat surface. All of the type is in cultivation. Where well drained it is an excellent soil for small grains. Corn also does well. The Wabash silty clay loam includes a small area of Wabash fine sandy loam, which is too small and irregular to be shown separately on the map.

Cape Girardeau County, Missouri

138. Only a very small area south and southeast of the city of Cape Girardeau is subject to flooding by the Mississippi River. Soil descriptions and a soil survey map for this county are available in Reference 25.

Scott County, Missouri

139. Significant Mississippi River floodplain areas exist in Scott County, but no source references were located.

Mississippi County, Missouri

140. Most of this county is low lying, but only a small portion of the northeast corner borders the Mississippi River north of Cairo, Illinois. No references that describe the soil in the area were located.

Climate

141. The movement of large masses of air into the Upper Mississippi River Basin* is an important climate control. Dry, cold air covers the area at times, but a large percentage of the total precipitation occurs when warm, moist air from the Gulf of Mexico dominates. About one-third of the rain in the Basin is ocean water, and about two-thirds represents evaporated surface water. Missouri and southern Illinois have warm, temperate, rainy climates with hot summers and comparatively mild winters.

Precipitation

142. Historical record. Weather data are primarily available through U. S. Weather Service stations at St. Louis, Missouri, and Cairo, Illinois. Useful precipitation data are also available on a less reliable basis from substations located at Praire Du Rocher, Chester, and Grand Tower, all on the Illinois side of the Mississippi River. Average monthly precipitation based on records from 1900-1972 is given in Table 1 for three weather stations.[26] Information such as this, including records of periods of intense, short-duration rainfall, is particularly necessary for Basin planning and project design, since intense rainfall makes up the major portion of the annual accumulation and results in the major local damages due to erosion and flooding.

143. Snowfall. Snowfall is part of the annual precipitation. Mean average snowfall, based on 1931-1952 data, runs from about 14 in./yr at St. Louis to 8 in./yr at Cairo, varying linearly for points

* Includes all of the Mississippi River Basin from Cairo, Illinois, northward.

in between. This amounts to about 5 percent of the total precipitation at St. Louis and a decreasing proportion farther south. Snow is both an asset and a liability. Its insulating properties protect certain vegetation and wildlife from the rigors of winter, and it is a valuable form of water storage. However, rapid snowmelt can result in flooding. Local snowmelt is of minor consequence in the St. Louis to Cairo portion of the Basin, but severe flooding is possible when northern portions of the Basin experience rapid snowmelt in the spring. Other factors can increase the danger of flooding from rapid snowmelt, such as frozen ground, rain, and the time sequence and areal distribution of such weather.

144. Runoff, infiltration, and evaporation. The average annual runoff ranges from about 10 in. at St. Louis to slightly more than 15 in. at Cairo. This results in annual flow at St. Louis on the Mississippi River as follows:

	Annual Runoff* 10^5 acre-feet
Minimum	49.01
Average	126.42
Maximum	248.78

* Based on 1861-1965 recorded data. Maximum and minimum values are based on any 12 continuous months, not limited to calendar, water, or climatic years.

145. A monthly distribution of mass runoff for the Mississippi River at St. Louis is shown in Figure 16.[27]

146. Infiltration rates are particularly important for storm rainfall-runoff and snowmelt-runoff studies. Saturation or freezing of the ground greatly reduces the ability of the ground to absorb additional moisture, and most rainfall or snowmelt becomes runoff. Infiltration rates are important for planning flood protection and are usually conservative. They range from 0.03 to 0.15 in./hr within the Basin, but

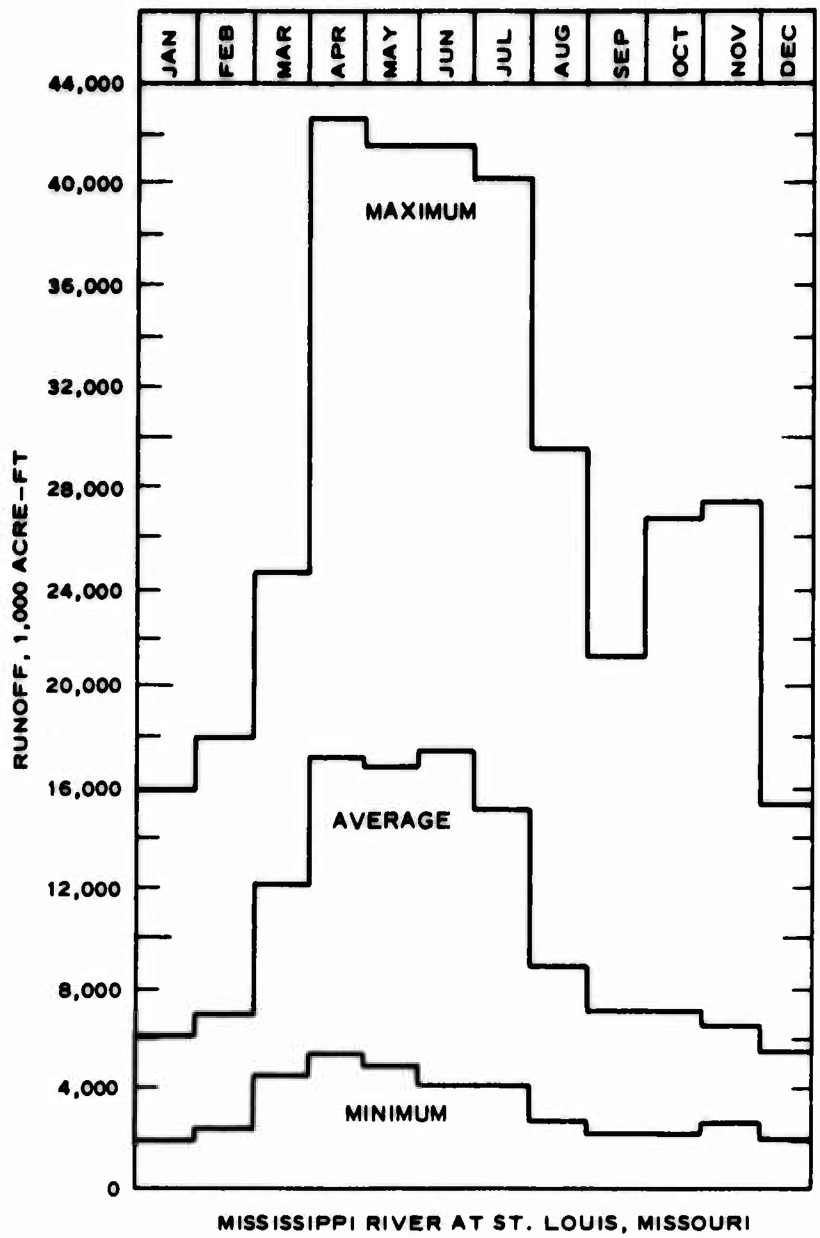


Figure 16. Mississippi River flow at St. Louis, Missouri[27]

are only about 0.03 in./hr in that part of the Basin between St. Louis and Cairo.*

147. Evaporation may become important in sizing storage reservoirs, particularly when reservoirs have large surface areas coupled with limited storage capacity. Annual lake evaporation for the St. Louis to Cairo area is about 36 in./yr. Values decrease to 24 in./yr in the northern parts of the Basin. The average annual potential evapotranspiration runs between 30 and 33 in./yr. Basin figures average from 24 in./yr in the north to about 30 in./yr and more from St. Louis southward.

Temperature

148. Historical record. Temperature data are available, for the most part, only for the "first order" Weather Service stations in St. Louis and Cairo. The annual temperature for this region averages about 55 to 60°F. Additional temperature data are given in the following tabulation.

Temperature Factors	St. Louis	Cairo
Average annual temperature (deg F)	56	58
Mean annual number of days with maximum temperature 90°F and above	45	60
Mean annual number of days with minimum temperature 32°F and below	90	60
Mean date of last 32°F temperature in spring	Apr 10	Apr 10
Mean date of first 32°F temperature in autumn	Oct 20	Oct 30
Mean annual total heating degree-days (base 65°F)†	5000	4000
Mean annual total cooling degree-days (base 65°F)††	1500	1700

† Used to aid in the measurement of heating requirements. A heating degree-day is a form of degree-day used as an indication of fuel consumption; on heating degree-day is given for each degree that the daily mean temperature departs below the base 65°F.

†† Used to measure the need for air conditioning or refrigeration. One cooling degree-day is given for each degree that the daily mean temperature rises above the base of 65°F.

* Rates are those at which saturated soil can absorb and transmit additional moisture to lower strata.

149. There is a rather uniform temperature rise from north to south in the immediate Mississippi River bottom area. This is characteristic of major valleys in flatland areas and is due to the sheltering effects of protective cliffs bordering the bottomlands. Basin waters cool gradually with the coming of cold weather, and no significant temperature stratification occurs. Ice forms in the Mississippi River above Cairo, but does not necessarily stop navigation, particularly for steel-hulled towboats and barges. Summer temperature readings taken of the Mississippi River water surface during a 11-yr period at St. Louis seldom exceeded 82°F, and never exceeded 84°F during July and August, even when St. Louis had hot spells of over 100°F. Surface water temperatures have been as low as 65°F in the early half of July.

150. Average monthly and record temperature information for St. Louis and Cairo, based on 72 yr of record from 1900 to 1972, are given in Table 1.[26] No reliable temperature information is available for intermediate points, but interpolation can be used, since temperature changes at a fairly constant rate northward or southward along the river valley.

151. Daily temperature cycle. The daily temperature cycle in the Upper Mississippi River Basin, to include the area from St. Louis to Cairo, is characteristic of a continental climate[28] and is marked by large daily and day-to-day ranges of temperature. The cycle includes:

a. Temperature maximum occurs after local noon and minimum near sunrise.

b. Relative humidity varies inversely with temperature.

c. Wind generally increases and veers (clockwise change in direction) by day and decreases and backs (counterclockwise change in direction) by night.

d. Cloudiness and precipitation over a land surface increase by day and decrease by night; over water the reverse is true, but to a lesser extent.

e. Evaporation is markedly greater by day than by night.

f. Condensation is much greater by night than by day.

g. Atmospheric pressure varies diurnally or semidiurnally, according to the effects of atmospheric tide.

Effects on agriculture

152. Crop production is a function of a wide variety of elements, only some of which are directly related to climate. These factors include amount and distribution of precipitation, length and temperature of growing season, soil type, and crop being grown. Most crops grow well in the Mississippi River floodplain between St. Louis and Cairo. Historical temperature data presented herein indicate that between 60 and 90 days per year have minimum temperatures of 32°F and below. This would indicate an annual growing season of from 275 to 305 days. The temperature (43°F) at which there is little or no plant growth may also be used as a cutoff point and would indicate a growing season of about 245 to 275 days for the area between St. Louis and Cairo.[29]

153. An appropriate growing season can better be indicated by noting some of the crops grown within the study area, their usual planting dates, and typical harvest dates. This information is tabulated below.

Crop	Planting Date	Harvest Date	Approximate Growing Seasons, Days
Winter oats	Sep 1	Jun 15	285
Spring oats	Mar 15	Jul 1	100
Corn	Apr 15	Sep 1	140
Potatoes	Apr 8	Sep 10	145
Winter wheat	Oct 12	Jun 20	250
Garden vegetables	Variable	Variable	--

Severe weather

154. Tornadoes. The U. S. Weather Service began the systematic recording and reporting of tornadoes in 1916. Suspected tornadoes were evaluated by knowledgeable employees of the Weather Service, and only those cases that clearly indicated the characteristics of tornadoes were so classified. Recorded data for the St. Louis to Cairo study area are available from 1916 to the present. Some tornadoes are certainly never observed and some storms are incorrectly identified, but increasing population density, better communications and instrumentation, and an organized plan for reporting and evaluating severe weather phenomena constantly lessen the number of undetected tornadoes. Since the St. Louis

to Cairo area lies within the so-called "Tornado Belt," the tornado threat is ever present.

155. The most destructive winds experienced in the Basin are tornadoes. These are often termed cyclones by people living in the Mississippi River Basin states. There is a high incidence of tornadoes during the spring season. The tabulation below of all observed tornadoes for a 35-yr period (1916-1950) reported within the counties bordering the Mississippi River from St. Louis to Cairo illustrates this trend.[30]

Month	No. of Occurrences	Month	No. of Occurrences
Jan	3	Jul	1
Feb	0	Aug	2
Mar	17	Sep	2
Apr	2	Oct	0
May	8	Nov	0
Jun	1	Dec	1

$$\frac{\text{37 Tornadoes}}{\text{35 years}} = 1.06 \text{ tornadoes per year}$$

156. Approximately 60 percent of the tornadoes in the Midwest move from the southwest to the northeast, with 34 percent from other westerly directions; only 6 percent occur from the north and northeast. The period from 3 p.m. to 7 p.m. is the most common time of occurrence. This area should therefore expect a typical tornado to come out of the southwest on a spring afternoon about once a year. Any given tornado may, however, come from any direction, travel any course whether straight or highly irregular, and occur at any time. On 11 Apr 1965, for example, Iowa, Illinois, Wisconsin, Michigan, Indiana, and Ohio reported 37 tornadoes that caused 271 deaths, more than 1000 injuries, and about 250 million dollars damage. Most damage is caused when tornadoes hit heavily populated areas; Chicago has been hit six times; and three of the most destructive tornadoes in history occurred in Missouri, two at St. Louis and one at Cape Girardeau.

157. In relation to property damage associated with tornadoes during the period 1916-1950, Illinois, with $48,705,650 property damage, ranks second only to Oklahoma. Missouri had $44,854,700 property damage

for the same period. Within the study area, St. Louis, Cape Girardeau, and Cairo are areas most likely to sustain heavy damage in the event of a tornado. Tornado statistical data for the states in the Upper Mississippi River Basin for the period 1916-1950 are summarized in Table 2.[30,31] Data for the period 1950-1970 are available from Reference 32.

158. Other severe weather. High winds in tornadoes play such an important role that there is a tendency to overlook the associated heavy rains and large hail that are also often present. Heavy showers are common, especially following a tornado; hail may also occur before or after, and hailstones ranging up to 7 in. in diameter have been reported near or along tornado paths.

159. Thunderstorms, accompanied by lightening and thunder, usually with strong gusts of wind, heavy rain, and occasional hail, are common to the study area. Thunderstorms are usually of short duration and are an important source of needed moisture; flash floods may result in some cases, however. There are about 60 thunderstorm days annually, with the greatest activity in the summer and the least in the winter. Thunderstorm damage is most often caused by lightning. Human deaths attributed to lightning average about five per year per million population, and damage amounts to an average annual monetary loss to farm buildings of about $8,000,000 in Missouri and a similar amount in Illinois.[27] Hail is another by-product of thunderstorms and has caused some miscellaneous damage; crop loss to hail has been considerable, as indicated in Table 3.[27] The frequency of occurrence of hail with thunderstorms averages about 5 percent, which translates to approximately 3 days annually with hail for the study area. Hail is most likely to occur between 2 p.m. and 9 p.m.

160. Miscellaneous severe weather includes both drought and floods. Drought conditions have produced large but undetermined losses, particularly in the early 1930's. Severe droughts still occur from time to time in the Mississippi River Basin, such as in 1954 and 1964. Flooding, the other extreme, is a problem whenever snowmelt and certain other hydrologic factors combine.

PART III: CULTURAL ELEMENTS

Population Factors

Census information (1960 and 1970)

161. The counties along the Mississippi River from St. Louis to Cairo are primarily rural. The only city of significant size bordering the river, other than St. Louis and Cairo, is Cape Girardeau, Missouri, with a 1970 population of approximately 31,000.

162. Population counts and population density on a county basis are presented in Table 4.[33,34] St. Louis County, Missouri, and St. Clair County, Illinois, are part of the St. Louis metropolitan area and consequently show a very high population density. Overflow of this urban population to the southwest also raises Jefferson County population density somewhat. In general, however, densities run much less than 100 people per square mile on a countywide basis.

163. A further breakdown to a township basis results in Tables 5[33] and 6[34] for Missouri and Illinois, respectively, where numbers in parentheses indicate principal city population included in township numbers. These townships border the Mississippi River and, although not necessarily defining the floodplain population between St. Louis and Cairo, township figures are highly indicative and the best available in any case. They are more significant for Illinois, which has extensive floodplain area.

Population trends

164. Recent population trends show a gradual shift from rural to urban areas. Populations for 1950-1970 on a statewide basis are presented in Table 7 to illustrate this phenomenon.

165. The Upper Mississippi River Comprehensive Basin Study (UMRCBS)[35] gives population projections by plan areas within the Upper Mississippi River Basin. (The Upper Mississippi River Basin is divided into 16 plan areas for study purposes.) Areas are defined according to hydrologic criteria; the river-border counties being considered are included in plan areas as follows:

Plan Area 6 Kaskaskia (Illinois)	Plan Area 7 Big Muddy (Illinois)	Plan Area 8 Meramec (Missouri)
St. Clair	Jackson	St. Louis
Monroe	Union	Jefferson
Randolph	Alexander	Ste. Genevieve
		Perry

Areas 6 and 8 include parts of the St. Louis metropolitan area. Population growth projected through the year 2020 (based on 1960 index of 100) for plan areas 6-8 is presented in the following tabulation.[35]

		Index by Years			
No.	Plan Area	1960	1980	2000	2020
6	Kaskaskia	100	125	157	204
7	Big Muddy	100	120	146	190
8	Meramec	100	138	192	260

Based on U. S. Census data available for 1960 and 1970, the population growth for this 10-yr period (based on 1960 index of 100) for Missouri is 108 and Illinois 109.

166. A definite population shift from rural to urban areas is projected. Estimates are not available for floodplain areas as such, but UMRCBS projections for the three areas are given in the following tabulation.[35]

		Nonfarm Population*				Farm Population*			
		Population Thousands	Index Based on 1960 = 100			Population Thousands	Index Based on 1960 = 100		
No.	Plan Area	1960	1980	2000	2020	1960	1980	2000	2020
6	Kaskaskia	642.3	131	169	222	71.6	69	52	47
7	Big Muddy	194.6	125	158	209	28.7	86	65	61
8	Meramec	1797.0	141	198	268	66.8	58	39	38

* Based upon employment in nonfarm and farm categories and dependency ratios related to those employment categories.

Using the data from Table 7, indexes for the states and categories were computed as given in the following tabulation.

State	1970 Population Index Based on 1960 = 100 Total	Rural	Urban
Missouri	108	97	114
Illinois	109	97	113

Conclusions

167. The size of the St. Louis metropolitan area is reflected in the high population densities of northernmost counties within the study area. The lowest population densities are found in Ste. Genevieve and Perry Counties in Missouri. Union County, Illinois, also is sparsely populated and showed a net decline of 8.9 percent over the past decade. Most counties show an increase in this decade, but the Illinois counties have a major part of the floodplain and require particular attention. County figures must be used with care. For example, the 30.5 percent increase in Jackson County shown in Table 4 is not reflected in township populations presented in Table 6. In fact, the data in Table 6 indicate floodplain population is relatively stable. (The data in the two tables are from different sources.)

168. The preceding figures seem to indicate that the St. Louis metropolitan area will continue to grow as will the few large towns. Very small villages and rural areas in general should experience a decline in population over the next few decades. However, in light of recent (1974) price rises in food commodities, the decline in rural and farm populations may not be as great as in the past decades.

Economic Conditions

169. Tables 8 and 9 present county-level information for Missouri and Illinois on both a rural farm and rural nonfarm basis.[36,37] Since few cities exist on or near the Mississippi River floodplain between St. Louis and Cairo, these figures reflect typical incomes of people living on the floodplain in rural environments. Particular note should be made of the large percentage of families whose incomes fall below the poverty level, noting the general increase in this figure with increasing distance from the St. Louis metropolitan area. These levels range

up to a high of 33.4 percent for Mississippi County, Missouri. Tables 10 and 11 contain income data on both county and state basis to include urban areas, and a noticeable decrease in poverty level percentages is shown. Ste. Genevieve and Cape Girardeau Counties in Missouri and all listed Illinois counties have significant floodplain areas, and the generally low incomes noted in county summaries are necessarily important factors for consideration.

170. UMRCBS[35] estimates personal income through 2020 according to plan areas. The St. Louis to Cairo region falls within three plan areas with indexes of personal income given in the following tabulation.

		Index, Based on 1960 = 100					
No.	Plan Area	1970	1980	1990	2000	2010	2020
6	Kaskaskia	134	176	226	300	389	482
7	Big Muddy	137	182	234	308	400	488
8	Meramec	134	173	215	273	246	423

Occupation

171. Tables 12 and 13 list 1970 census information on occupations within those counties bordering the Mississippi River between St. Louis and Cairo.[36,37] Manufacturing is the major occupational grouping in all counties, but is particularly significant in the St. Louis metropolitan area and nearby counties. Employment in the agricultural, forestry, and fisheries occupations is significant in several counties, and percentages for this grouping of occupations are tabulated below. The highest percentages (> 10 percent) in the tabulation are generally associated

Missouri*		Illinois**	
St. Louis	0.62	St. Clair	1.76
Jefferson	1.55	Monroe	12.94
Ste. Genevieve	8.01	Randolph	9.46
Perry	15.34	Jackson	3.67
Cape Girardeau	6.94	Union	10.21
Scott	7.09	Alexander	5.61
Mississippi	20.39		

* State = 4.80 percent.
** State = 2.30 percent.

with areas having high percentages of incomes below the poverty level and comparatively low values for total employment and median income, except in the case of Monroe County (Tables 10 and 11). The higher employment and earnings data for Monroe County reflect the influence of the nearby St. Louis urban area.

172. Projected employment indexes, based on UMRCBS plan areas,[35] are given as follows:

No.	Plan Area	Index, Based on 1960 = 100 1980	2000	2020
6	Kaskaskia	127	160	209
7	Big Muddy	127	161	204
8	Meramec	140	192	259

173. Additional 1970 census data are available in Tables 10 and 11. For example, Table 11 indicates that Jackson County, Illinois, has a high 54.6 percent in white-collar occupations and 38.9 percent in Government employment. Similarly, Alexander County's poor economic health is evidenced by a median income of $5,471, 31.2 percent of families on a poverty level, and a high nonworker-worker ratio of 1.86.

174. UMRCBS employment projections based on specific industries are given in Table 14.

Business patterns

175. Tables 15 and 16 portray the nature and size of business activities for counties along the Middle Mississippi River for 1971.[38,39] It should be noted that these tables exclude Government employees, railroad employees, and self-employed persons. The tables are useful in evaluating size and relative importance of specific industries likely to be affected by floodplain modification. Data on the number of employees for various industries are provided for the states of Illinois and Missouri in Table 17 for comparison with data in Tables 15 and 16.

176. The UMRCBS projects growth for 1980, on a plan area basis, for selected industries. These data are given in Table 18.

Conclusions

177. The floodplain areas bordering the Mississippi River between St. Louis and Cairo are economically depressed, particularly those counties some distance from St. Louis. Median incomes are low and many families subsist at poverty levels. Most employment is in industry, although a higher-than-average number of people farm for a living. Projections indicate that personal income and industrial output will increase significantly in the next few decades, but generally will remain below national levels.

Waterborne Commerce

178. Navigation on the Mississippi River has been important from the earliest time. The Mississippi served as an important artery of commerce in both the Civil War and World War I. The development of the modern diesel towboat, the deepening of the Upper Mississippi River to 9 ft, and the completion of the Illinois Waterway in 1940 have been most influential in developing the high volumes of cargo carried today. The 170-mile stretch of river in the project area is particularly noteworthy, since it connects the Missouri, Illinois, and the Ohio Rivers to the Mississippi River system. These waterways have taken their place alongside the rails, highways, pipelines, and airways as an integral part of the nation's transportation network. Like any transportation system, the type, size, and movement of commerce is affected by the nature of the cargo, geographical constraints, economic and social progress, and technical developments. Both St. Louis (with 70 barge terminals) and Cairo are important river ports, and St. Louis is both a major population area and an industrial center.

Trends

179. River transportation is more efficient at hauling certain heavy, bulk cargoes at a lower cost than any other present-day means available. A typical 4000-hp towboat, for example, can handle 20,000 tons of freight, which is equivalent to 620 loaded freight cars. Increasing water depths and improved towboats, coupled with a

Federal policy of toll-free use of Federally maintained waterways, often make barge shipment a preferred method. Graphs in Figure 17[41] reflect recent changes in market forces and shipment costs; certain commodity groups continue to be carried in increasing quantities while others fall off. For example, crude petroleum (Figure 17f, sheet 2 of 5) is increasingly moved by pipeline.

180. A breakdown of 1971 cargo tonnage for commodity groups carried on the Middle Mississippi River is presented in Table 19.[41] Specific items included in each commodity group can be determined by referring to "commodity classifications for shipping statistics" in Reference 41.

Cargo movement

181. Few tows have origins or destinations within the study area other than at St. Louis or Cairo. Festus (1970 population of 7530) and Cape Girardeau (1970 population 31,282), Missouri, and Chester (1970 population of 5310), Illinois, are the only other river towns; data were not available to determine to what extent these towns depend on river commerce.* The Middle Mississippi River is of much greater significance in terms of external commercial activity. Typical 1964 cargo movements in this area include, for example:

a. Selected grains: Movement is almost exclusively southbound to New Orleans from points north of St. Louis.

b. Bituminous coal: Coal from Ohio and southern Illinois is transported to power plants on the Mississippi River.

c. Petroleum and petroleum products: Principal movement is northbound from Gulf coast areas to St. Louis, Minneapolis-St. Paul, and Chicago. Southbound shipments move from St. Louis, Minneapolis-St. Paul, and Chicago to destinations on the Ohio River.

d. Industrial chemicals and sulphur: Dominant movement is from the Gulf coast area northbound to major market areas such as St. Louis, Minneapolis-St. Paul, and Joliet-Chicago.

e. Iron ore, steel, and metal products: A variety of

* It is possible such data may be available at local Chambers of Commerce.

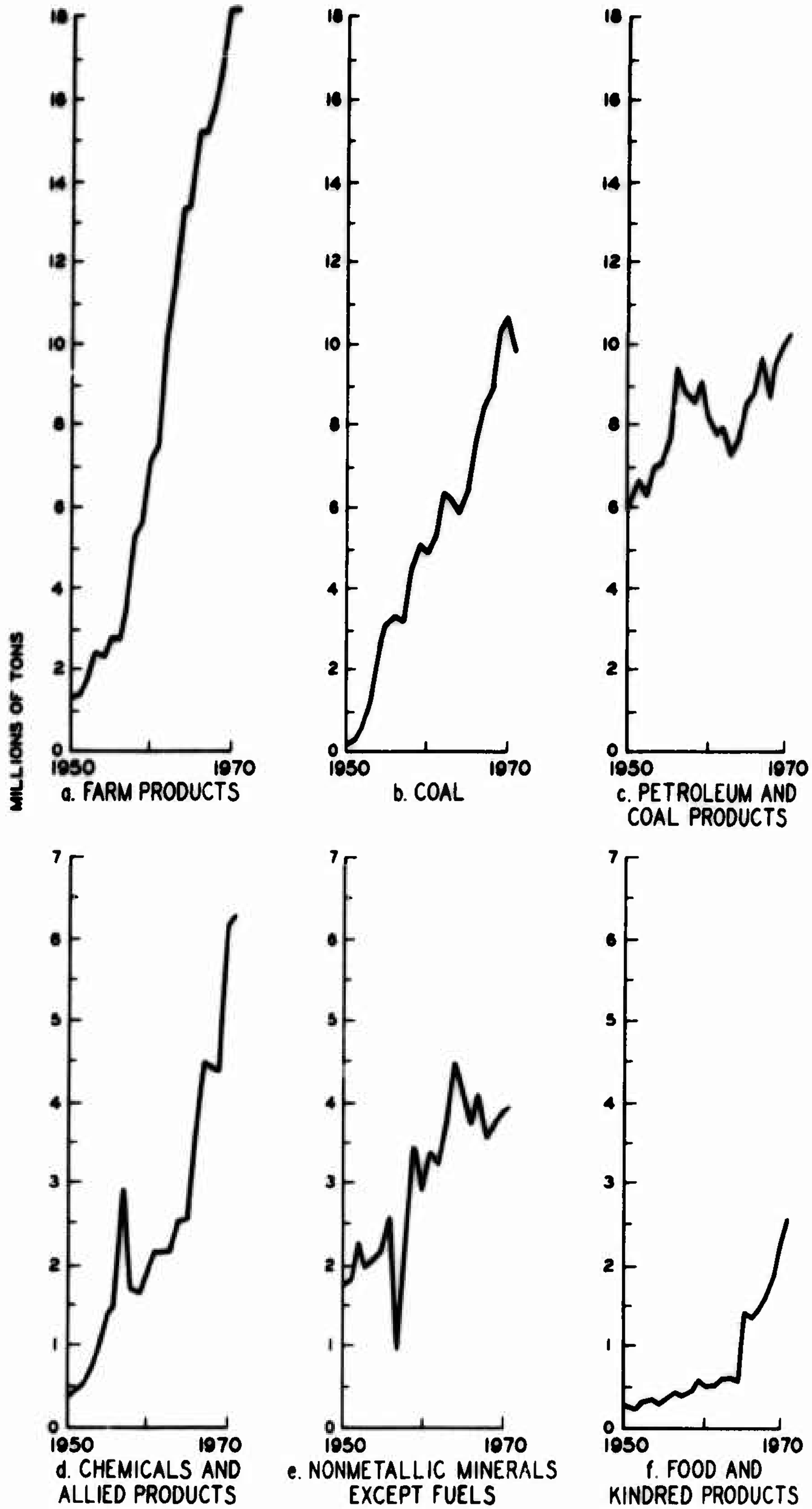


Figure 17. Trends in Waterborne Commerce (sheet 1 of 5)

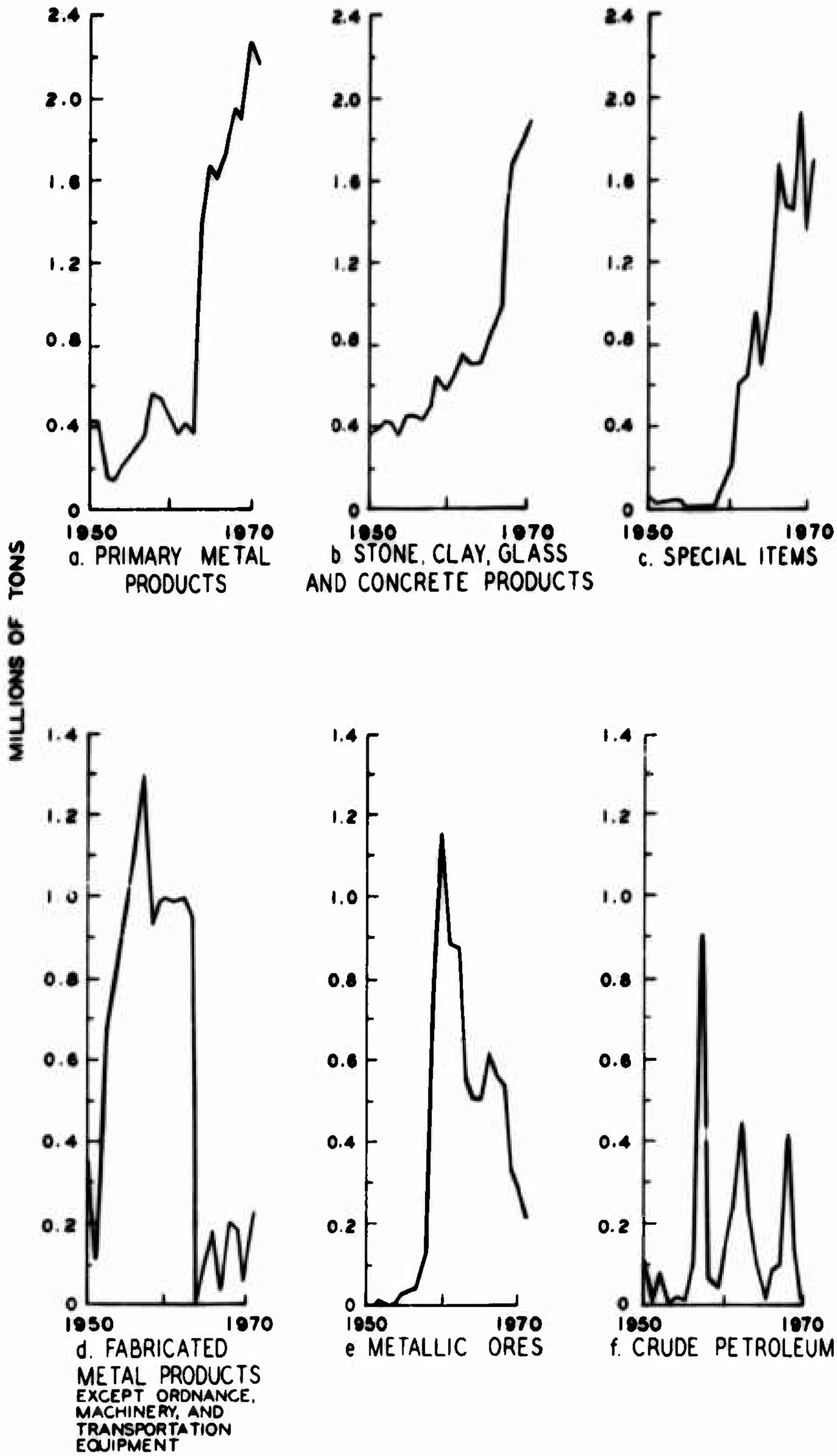


Figure 17 (sheet 2 of 5)

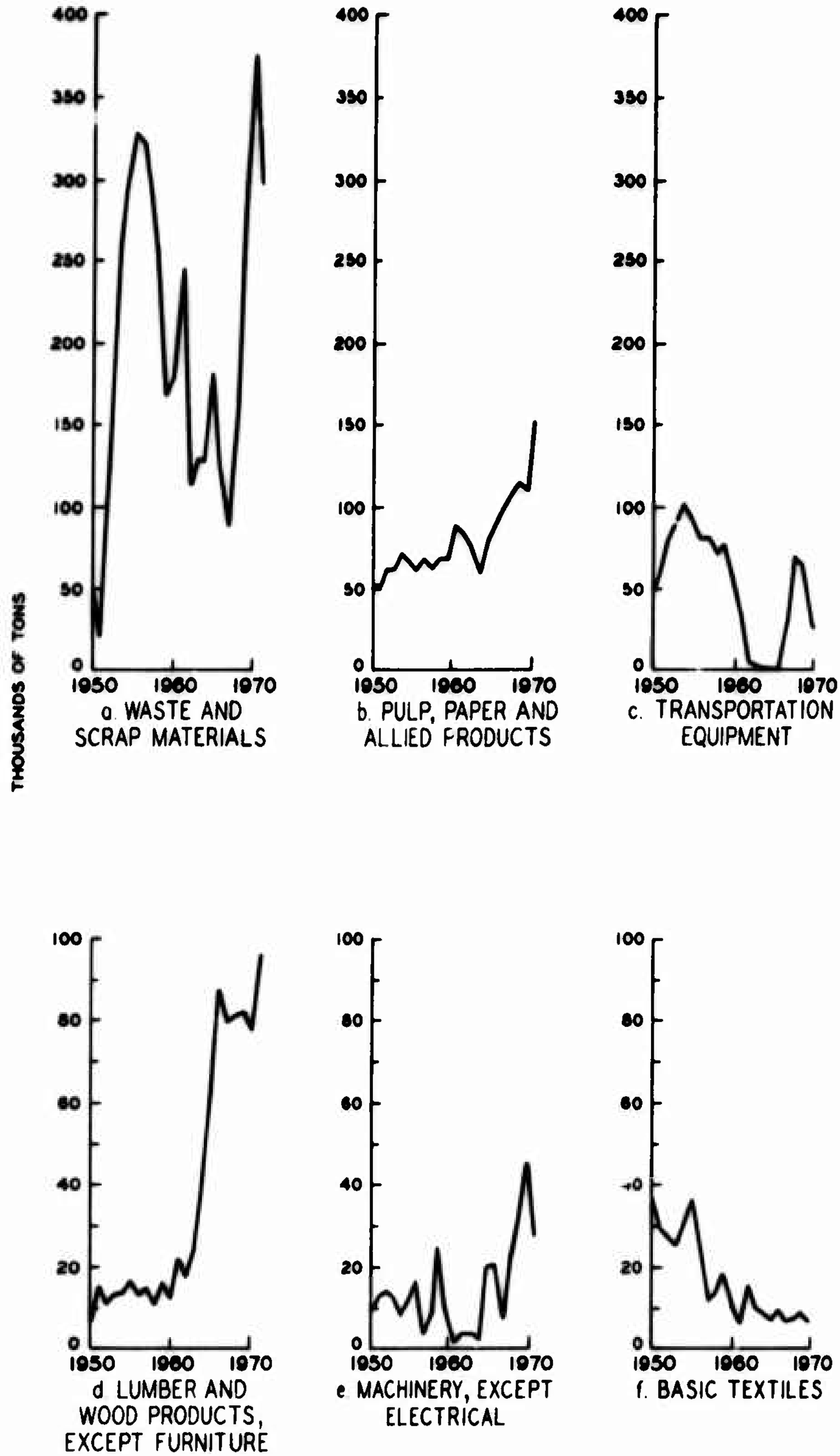


Figure 17 (sheet 3 of 5)

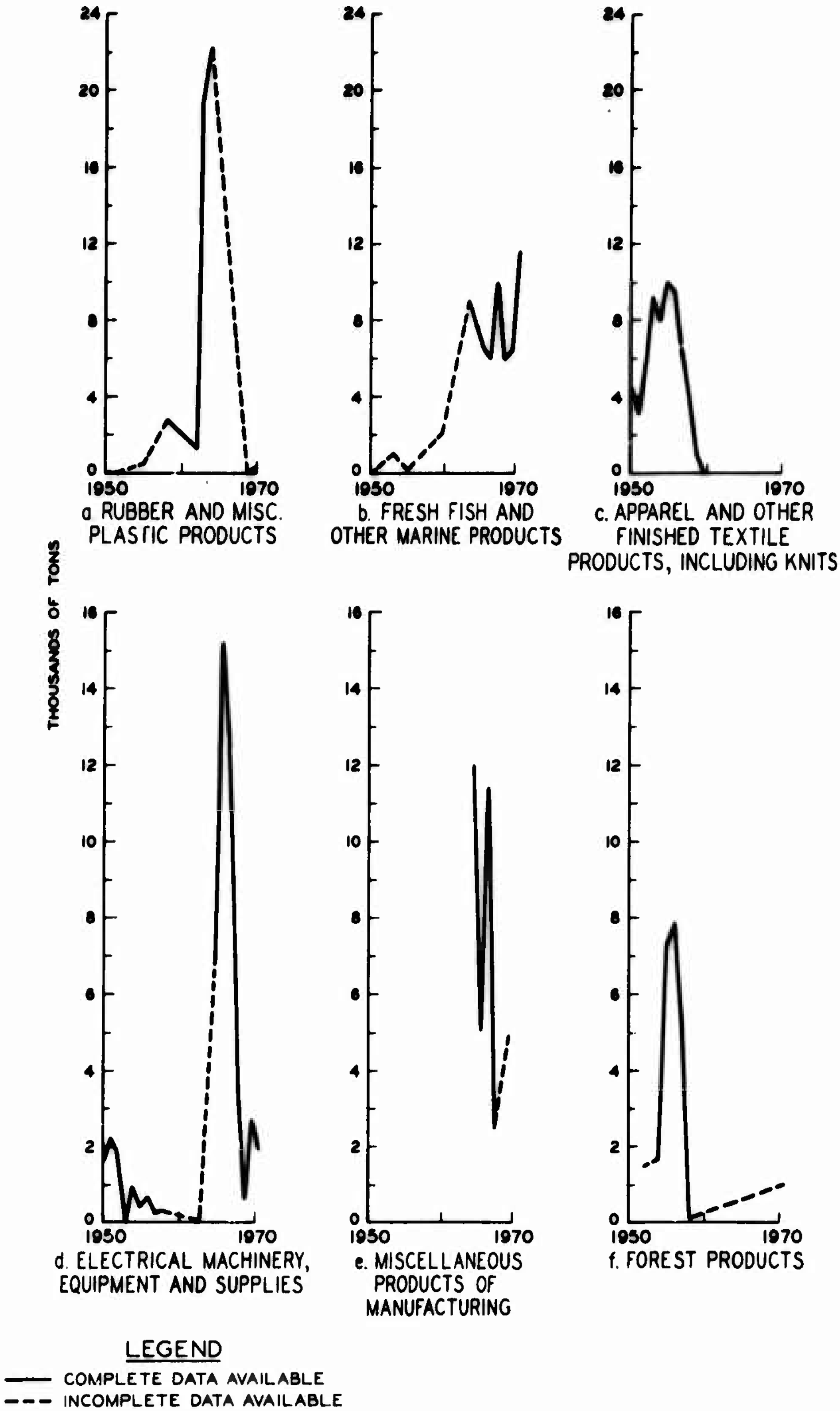
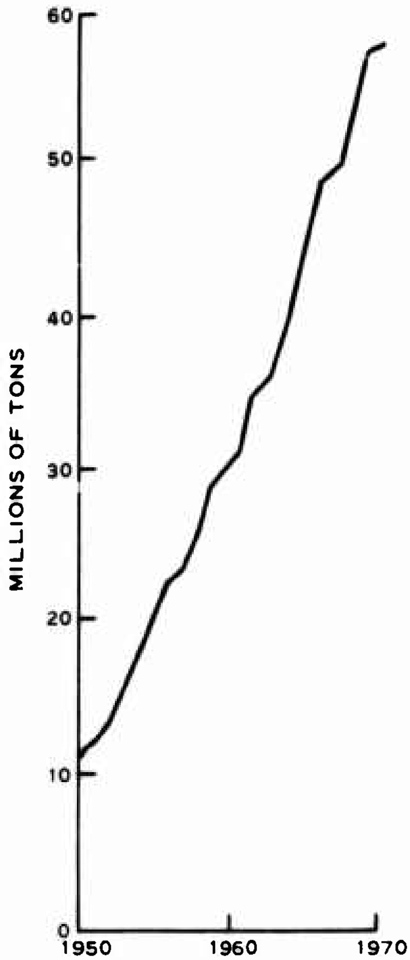


Figure 17 (sheet 4 of 5)

FURNITURE AND FIXTURES	1971	14 TONS
PRINTED MATTER	1966 1967	1828 TONS 3494 TONS
LEATHER & LEATHER PRODUCTS	1954	5 TONS

a. OTHER COMMODITIES-LIMITED DATA AVAILABLE



b. TOTAL OF ALL COMMODITIES

Figure 17 (sheet 5 of 5)

northbound and southbound movements occur between Gulf coast areas and St. Louis and other more northern ports.

f. Agricultural chemicals: Major movements occur northbound from the Gulf coast area to St. Louis, Peoria, Rock Island, and Minneapolis-St. Paul.

g. Salt: The major source of salt is the Gulf coast area with destinations at St. Louis, Chicago, and Minneapolis-St. Paul.

Projected waterborne commerce

182. Tonnages carried on the Middle Mississippi River can be expected to increase steadily with a growing national economy. Further technological improvement and intermodal transportation arrangements can be expected to increase barge transportation efficiencies, but pipelines, unit trains, and similar transportation innovations offer strong competition for specific transportation markets. Projected commerce, based on a 1964 index of 100, is presented in Table 20 in terms of low, medium, and high estimated indexes, which are derived from a series of alternative assumptions.

183. Some of the numerous assumptions on which the commodity commerce projections presented in Table 20 are based are discussed below.

184. Selected grains. The six major grain-producing states (Illinois, Indiana, Iowa, Minnesota, Missouri, and Wisconsin) account for approximately half of the nation's annual grain production and a similar proportion of its export. Most of this export moves by barge to New Orleans for transshipment to numerous Mediterranean, Middle East, Far East, and Latin American countries. Future grain traffic will be primarily affected by Government food programs, relative basin grain production compared to other U. S. grain-producing areas, and an increase in domestic consumption for both food and feed purposes.

185. Bituminous coal. Coal traffic on the Mississippi River is oriented towards the generation of electric power. Increasing coal requirements are forecast based upon a tremendous increase in power demand (requirements in the year 2020 are projected to be 18-fold those of 1964), modified by increasing use of nuclear power.

186. Petroleum and petroleum products. Previously one of the

major categories of waterborne commodities, petroleum and petroleum products are increasingly moved by pipelines being constructed parallel to present water routes. Residual fuel oil, lubricating oils and greases, aliphatic naphtha, and petroleum asphalt (which currently approximate 20-25 percent of 1964 total petroleum waterborne traffic) are expected to continue to move by barge because their high viscosity prevents economical pipeline transport.

187. Iron ore and iron and steel products. Adequate basin reserves and steadily increasing demand indicate that traffic in these commodities will continue to increase proportionately with the general trend in barge traffic. Rolled and finished steel-mill products are expected to account for an increasing share of the total traffic in iron ore and iron and steel products above the 27 percent reached in 1964.

188. Industrial chemicals and sulphur. Traffic in this commodity is expected to mirror increases in the production of iron and steel. Demand is directly related to projected industrial growth in the major metropolitan areas of Chicago, St. Louis, and Minneapolis-St. Paul.

189. Agricultural chemicals. Waterborne tonnage of agricultural chemicals is expected to show the strongest average annual growth of all commodity groups transported on the Upper Mississippi River. Future growth in production of agricultural chemicals may exceed 10 percent per year through 1980 as breakthroughs in the production and marketing of agricultural fertilizers take effect. A steady demand should continue through 2020.

190. Projected trend. While prediction of future waterborne tonnage for a specific commodity group may be in doubt, the general trend is upward as illustrated in Figure 18. A major portion of this Upper Mississippi River waterborne commerce must pass through the stretch of river between St. Louis, Missouri, and Cairo, Illinois.

Land Use

191. Aerial photomosaics of the Mississippi River floodplain were prepared by assembling 9- by 9-in. black-and-white infrared photographic

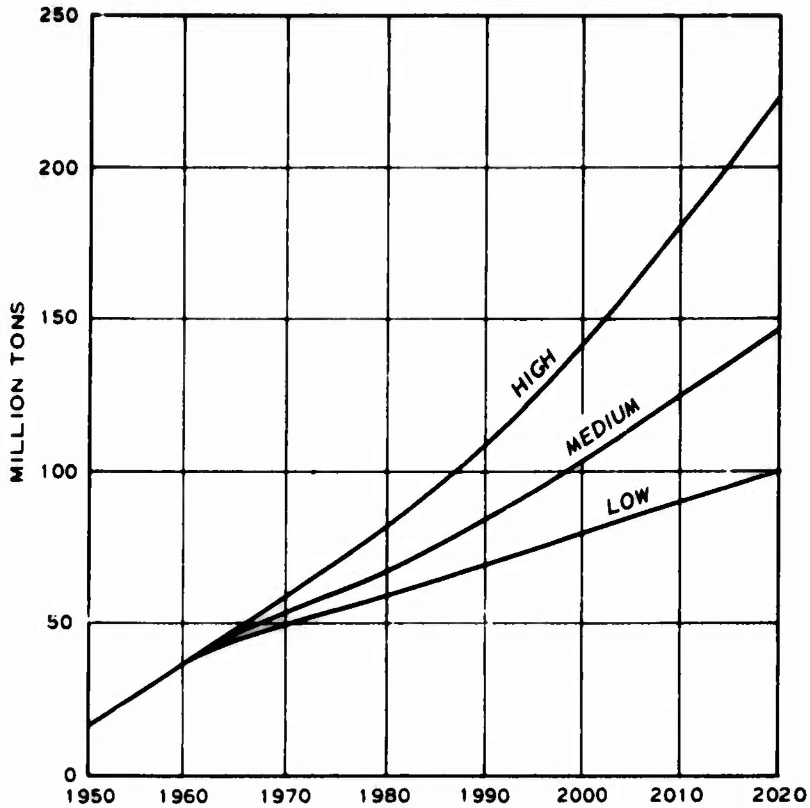


Figure 18. Total waterborne commerce, Upper Mississippi River, 1950 and 1960 actual - 1980, 2000, and 2020 projected[42]

prints. These mosaics were used as base maps for mapping land-use categories.

192. Photography taken 25 September 1965 was used to cover part of the floodplain from Cairo, Illinois, north to river mile 40 at a scale of 1:20,000. Photography dated 27 May 1969 covered the approximate stretch of floodplain from river mile 63 to mile 97 at a scale of 1:24,000, and photography dated 26 May 1969 covered all remaining river reaches, also at 1:24,000. Cairo to river mile 40 (Commerce, Missouri) is mapped from levee to levee, and from mile 40 to mile 71 (St. Louis) is mapped from bluff to bluff. An index map (Figure 19) is included to show the locations of the matched sheet maps portraying land use in Figure 20 (10 sheets).

193. The following items are identified on the maps in Figure 20:

<u>a</u>. Levee locations

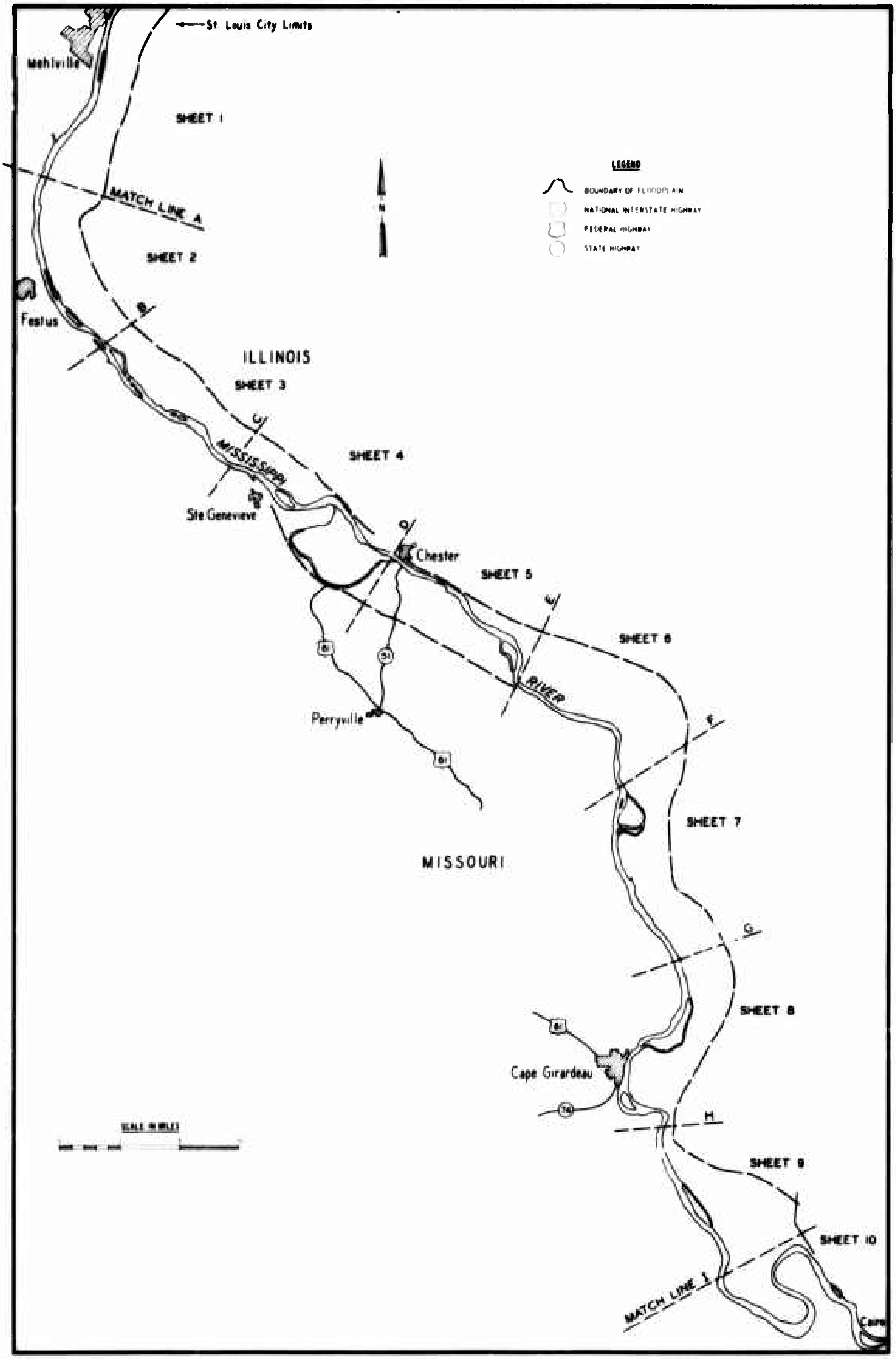


Figure 19. Index sheet for land-use maps shown in Figure 20 (10 sheets)

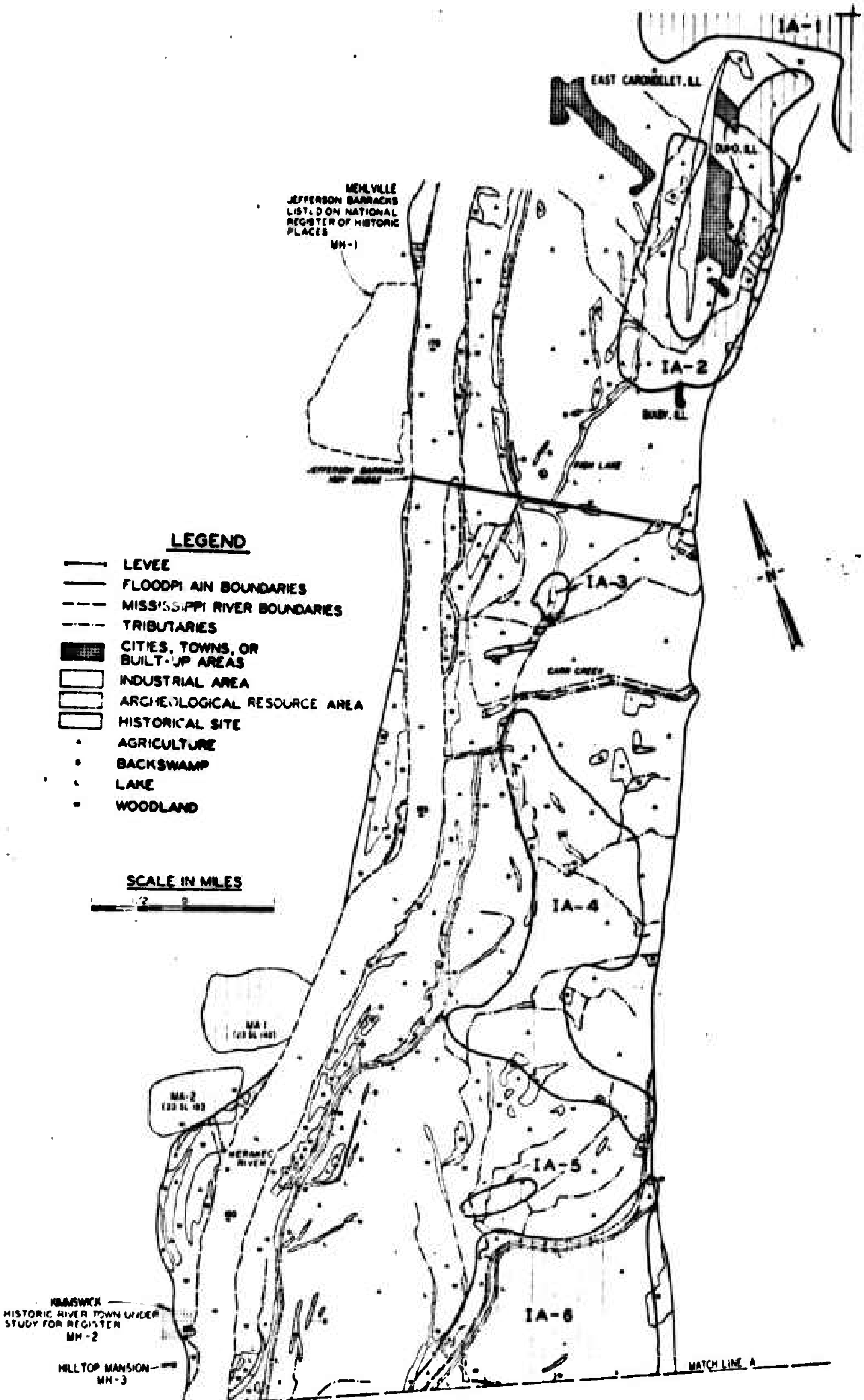


Figure 2C. Middle Mississippi River floodplain land-use, historical, and archeological sites (sheet 1 of 10)

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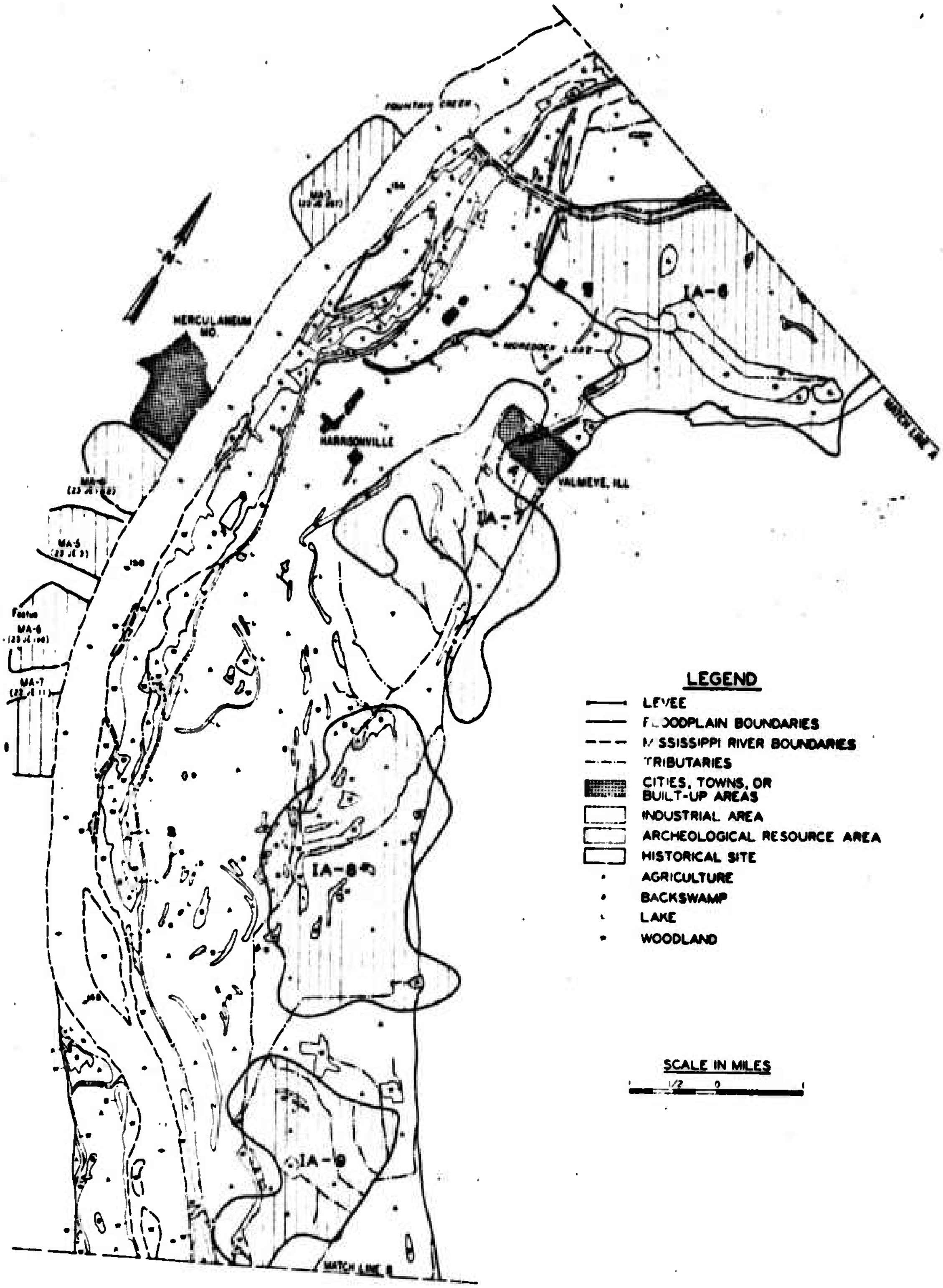

Figure 20 (sheet 2 of 10)

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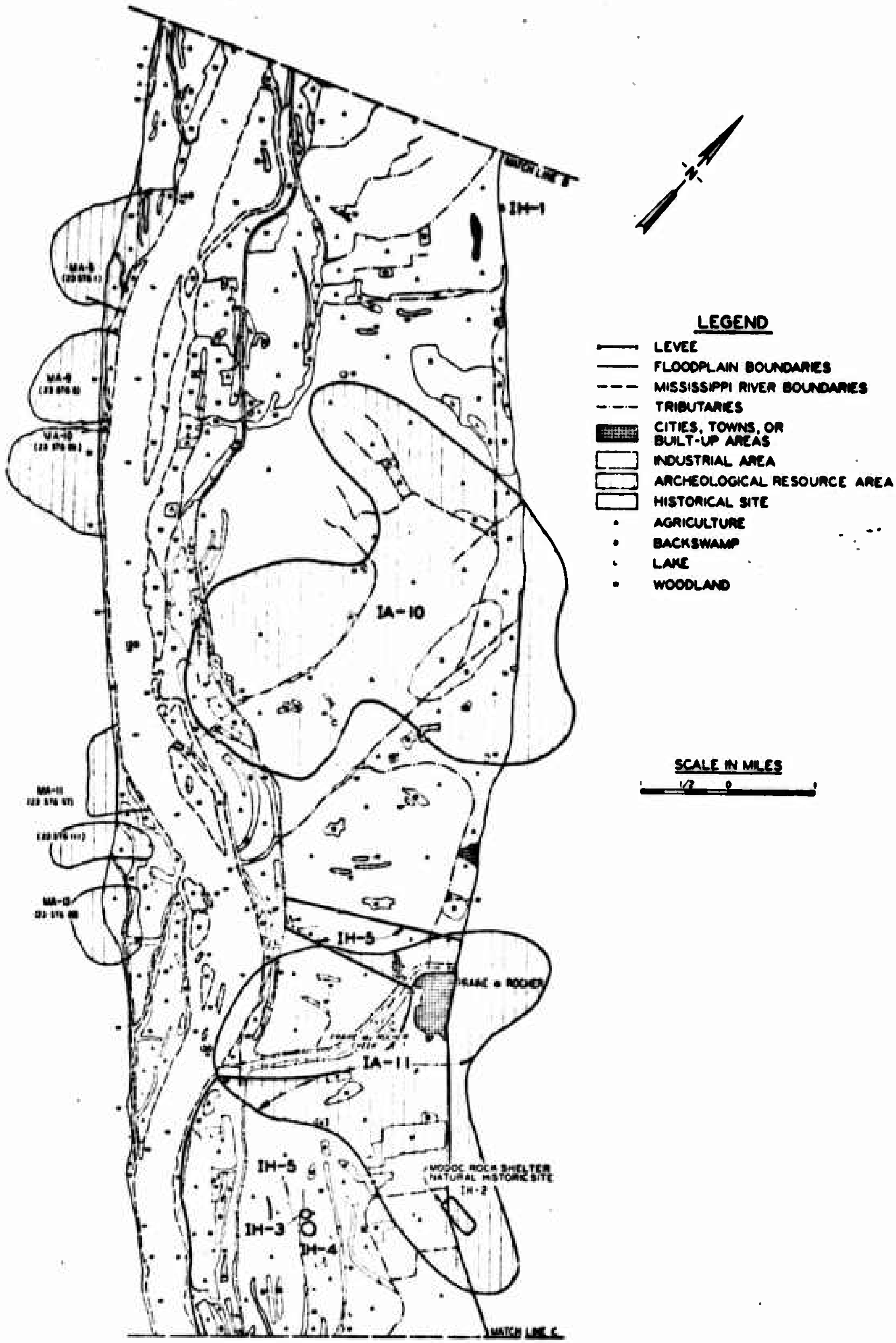

Figure 20 (sheet 3 of 10)

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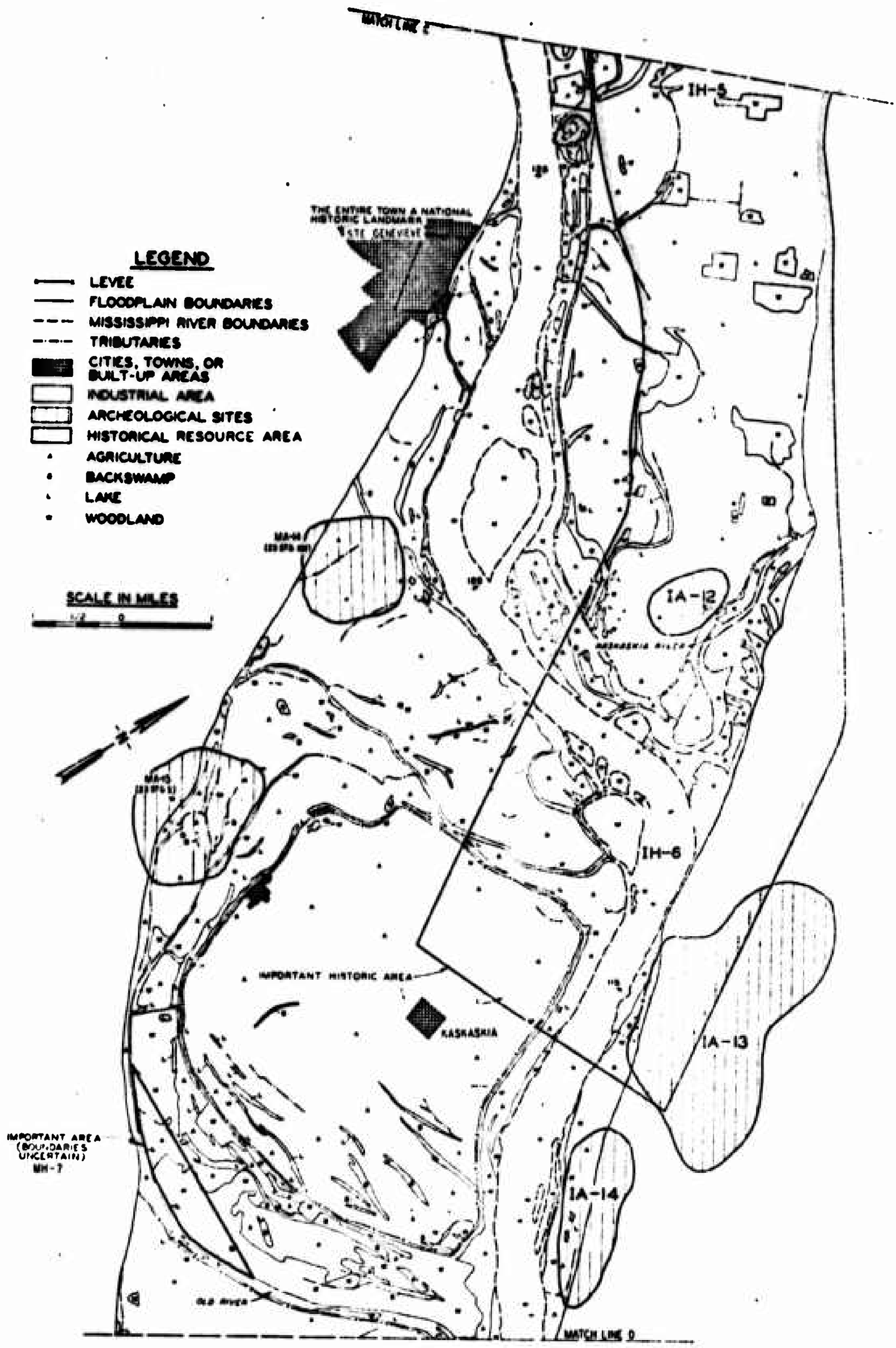

Figure 20 (sheet 4 of 10)

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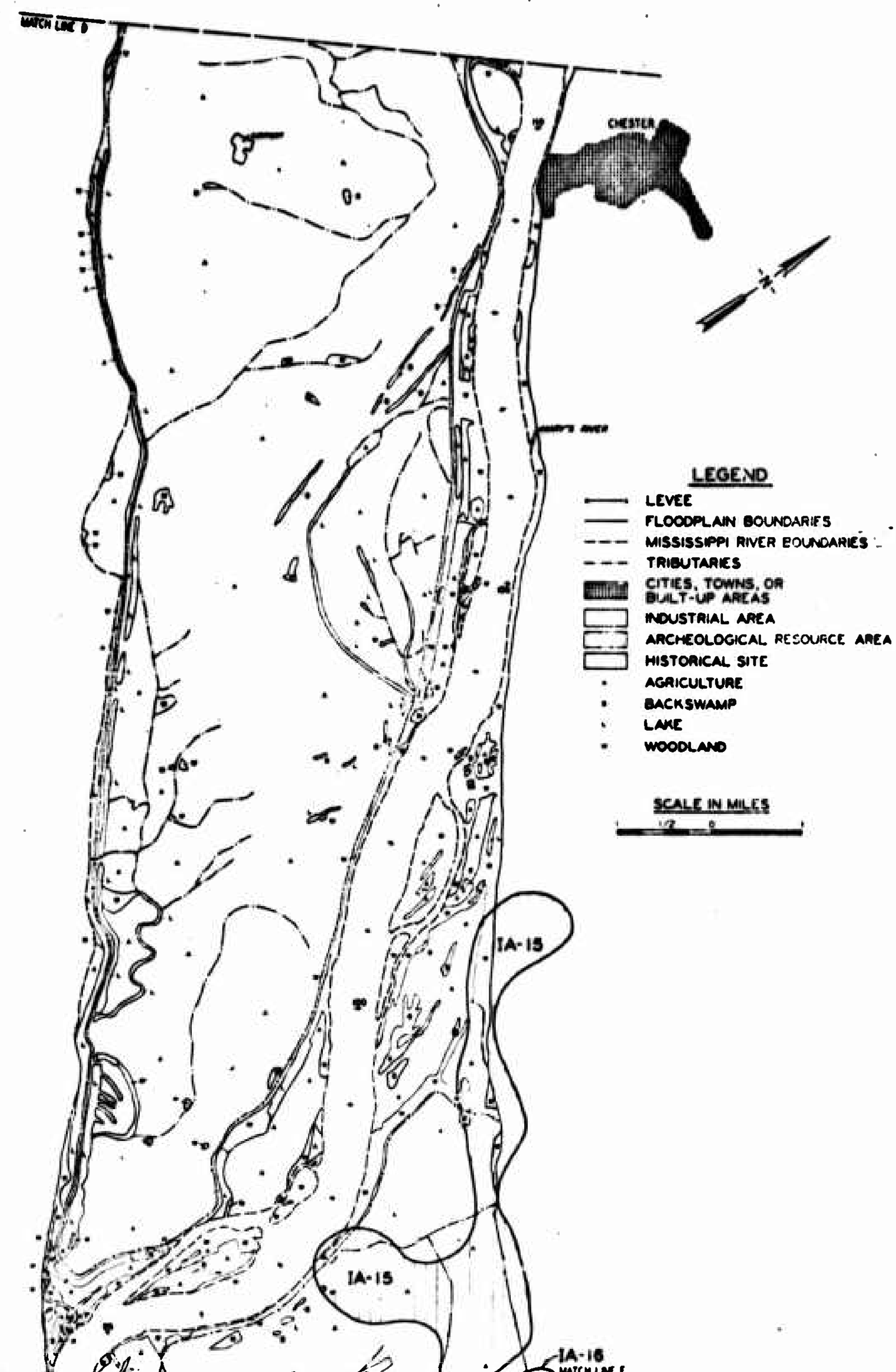

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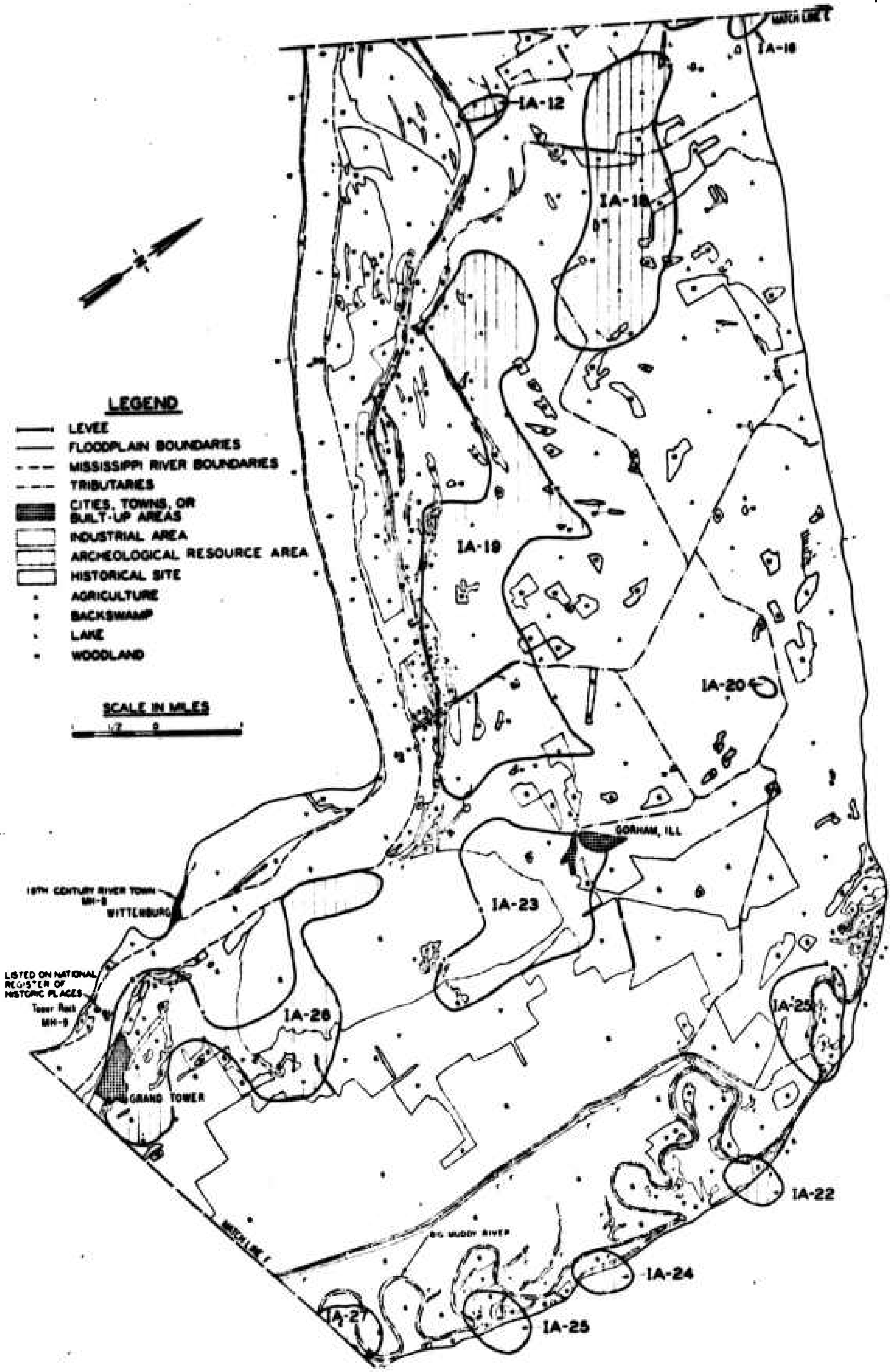

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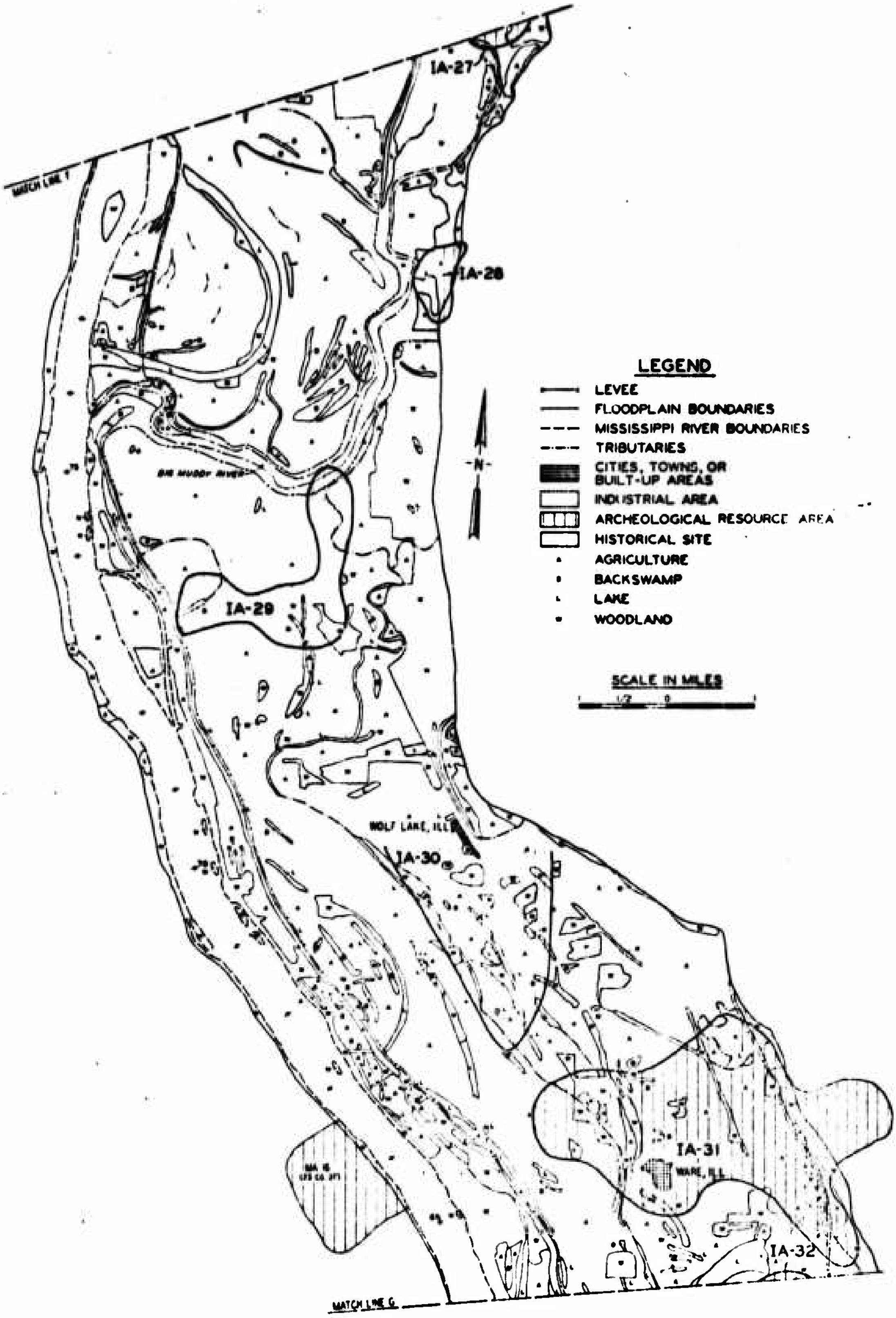

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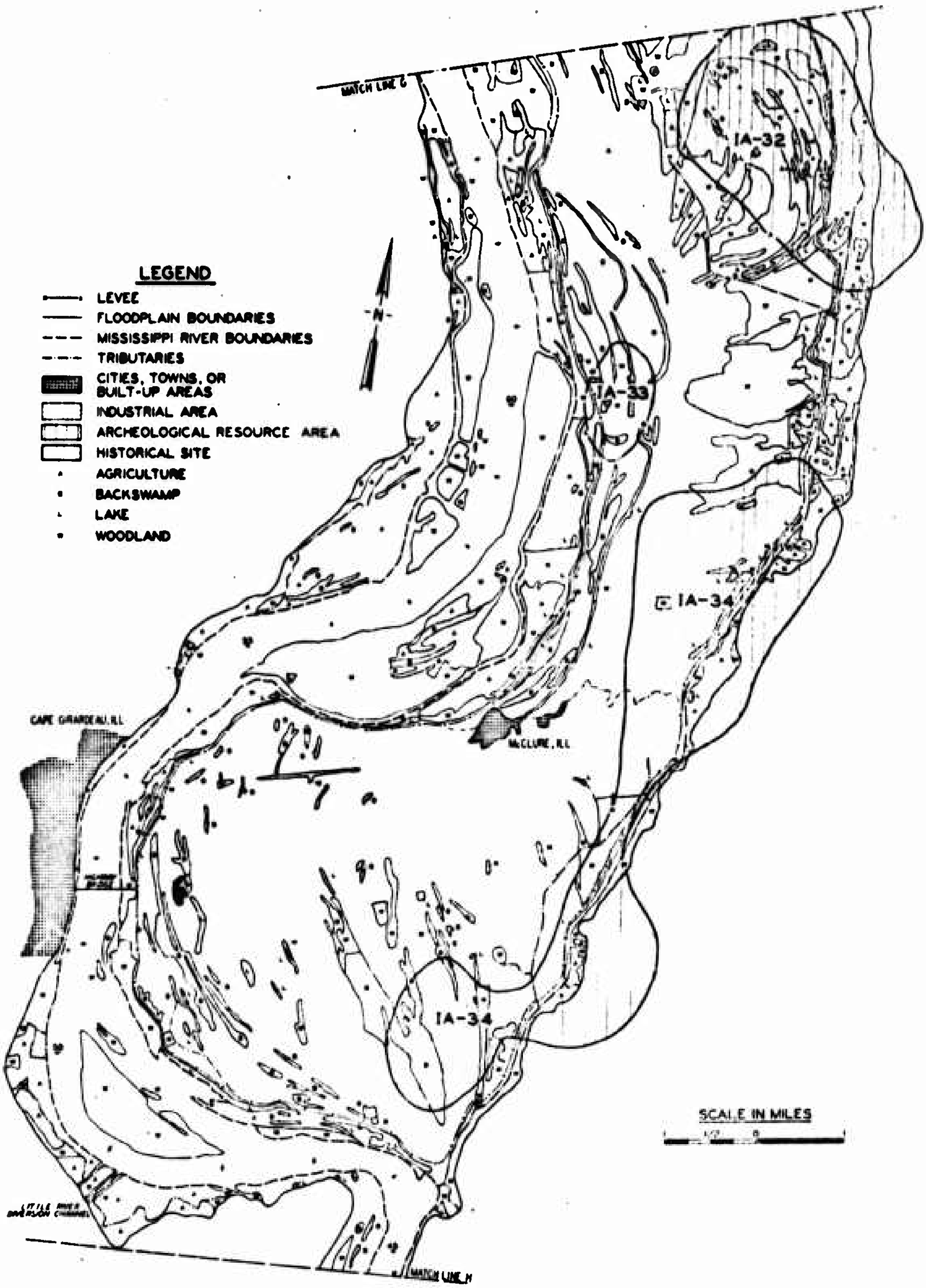

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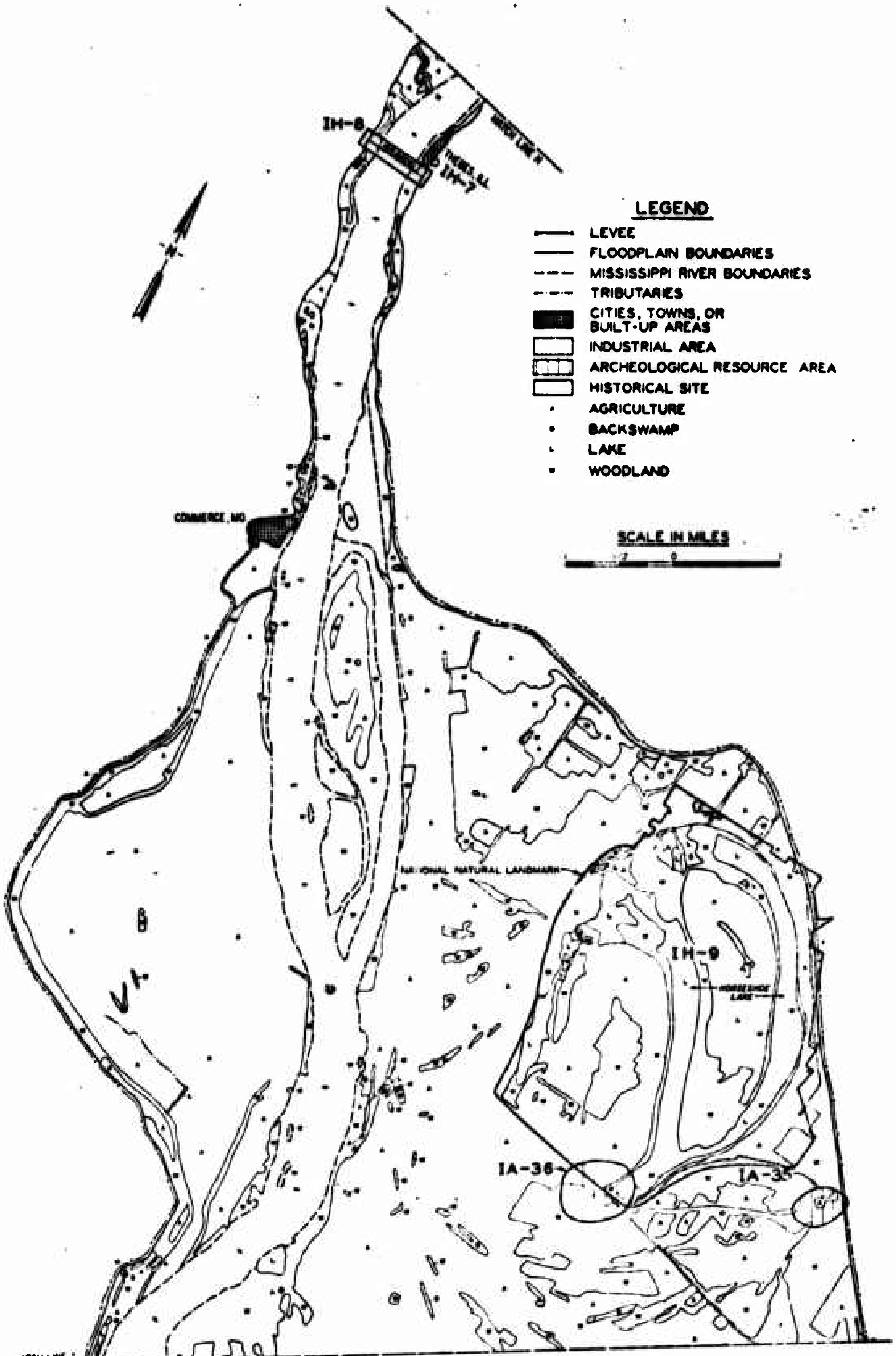

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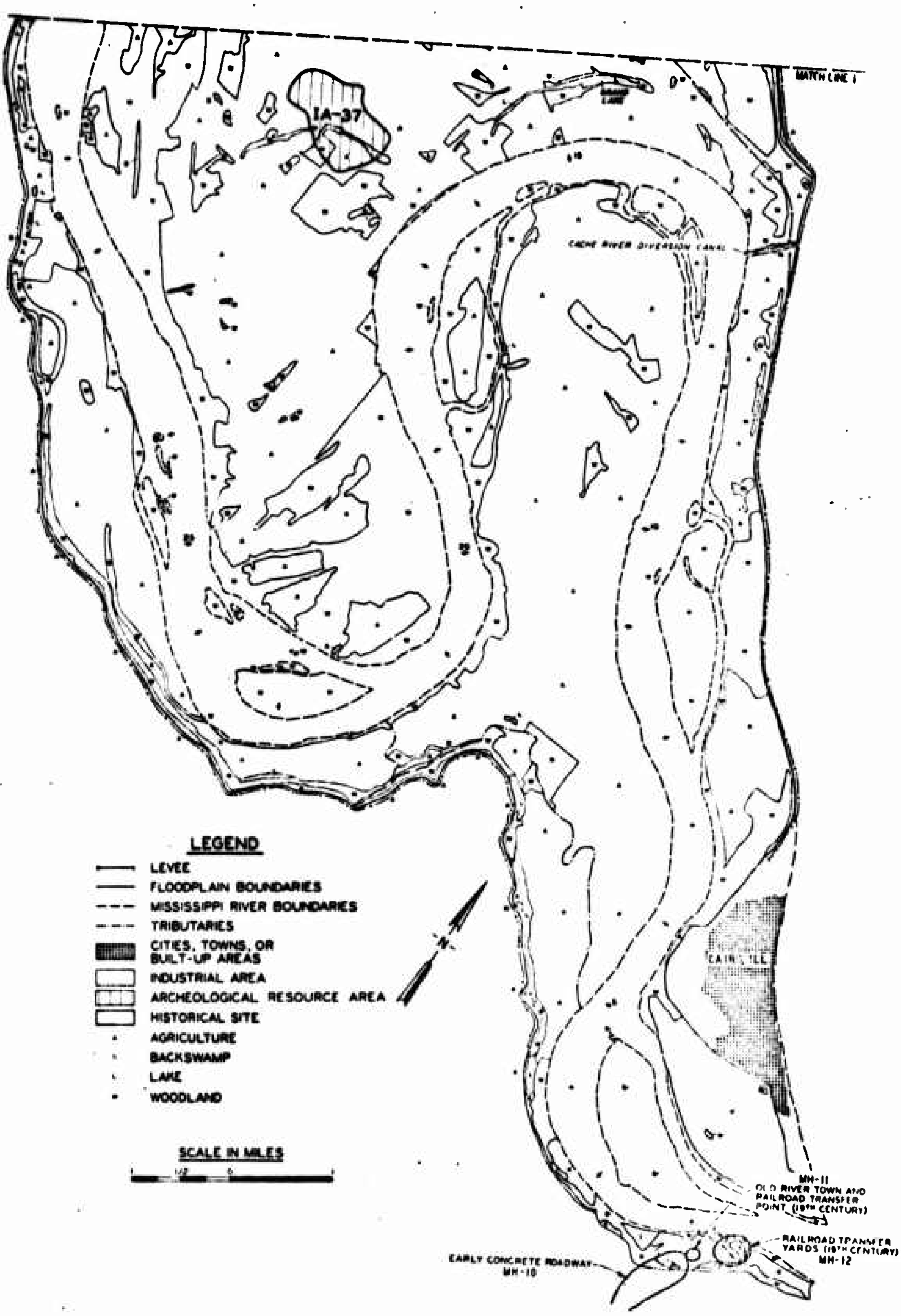

Figure 20 (sheet 10 of 10)

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b. Floodplain boundaries

c. Mississippi River channel boundaries

d. Tributaries to the Mississippi River

e. Cities, towns, or built-up areas

f. Major floodplain industries

g. Woodlands

h. Agricultural areas

i. Backswamps

j. Lakes

194. Cities and towns and other built-up areas that could be recognized on the photographs were delineated and established names attached.

195. Woodland areas are those covered by trees ranging from young willows and cottonwoods in the lowest areas adjacent to the main river channel and side channels to oak, hickory, and pine on the higher ground. The quality of the photography would have allowed mapping individual tree types, but such detail was not required for this report.

196. Agricultural areas include pasture or grassland and cropland. Backswamps are those low areas where water ponds on a seasonal basis.

197. Lakes include the permanent water bodies that may be open, have restricted exits, or be landlocked. Lakes occur frequently along the base of the levees on the riverward side. These lakes have formed in borrow pits resulting from levee construction. Others occupy abandoned river meanders and side channels. The most prominent lake in the study area is Horseshoe Lake southwest of Commerce, Missouri, on the eastern side of the floodplain just inside the levee boundary.

198. River stages occurring on the date the photographs were taken are given in the following tabulation. The land-use maps should

Location	Flood Stage ft	River Stage Gage Readings, ft 25 Sep 1965	26 May 1969	27 May 1969
St. Louis, Mo.	30	28.9	22.8	21.1
Chester, Ill.	27	27.3	22.6	22.7
Cape Girardeau, Mo.	32	30.8	26.5	27.5
Cairo, Ill.	40	26.0	32.1	32.2

be used with appropriate regard for the time of year and river stage represented.

199. The map overlays were checked for registration of major feature boundaries on 1:24,000 topographic maps. The main river channel and floodplain boundaries matched suprisingly well on the two sets of maps. In a few places main feature boundaries mapped from the photomosaics were shifted slightly on the overlays to coincide with boundaries on the topographic maps.

200. The land-use maps were used as base maps for showing locations of archeological and historical sites occurring in and adjacent to the river floodplain. Archeological and historical elements are discussed separately in the following section of this report.

Archeological Elements

201. The Illinois side of the floodplain is considerably richer in archeological remains than the Missouri side, primarily because it is so much larger. The information available, however, was much more specific in the case of Missouri. Additional information may be readily obtained by authorized persons from the reference sources cited in the text.* Persons who are involved with projects or activities requiring earth excavation or filling are advised to contact these sources to check the construction areas against the latest information on locations of archeological remains.

Illinois archeological resources

202. There are numerous areas of archeological interest in the Mississippi River floodplain, particularly on the Illinois side. This area was once inhabited by the race known as the Mound Builders, as evidenced by scattered mounds that still remain as monuments to their occupation. When the French Jesuits first visited this region, the country was inhabited by tribes of the Illinois Indians, branches of the great Algonquin family. General areas in the Mississippi River floodplain

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* For address see Appendix A.

have been designated as containing archeological remains, but in many instances precise locations of such remains within the general areas are not known. Considerable fieldwork will be required in these areas to resolve site locations.

203. The Illinois Archeological Survey (IAS) provided nonspecific map locations of archeological sites and would not release any other descriptive data. Available data are deliberately generalized at the insistence of the IAS to avoid site exposure and damage by amateur enthusiasts. Exact locations of individual sites within a designated general area may be available at the IAS. This information is released for official use only and on a "need-to-know" basis.

204. Areas are plotted in Figure 20 (10 sheets) as IA1* through IA37. There are about 400 known archeological sites in the floodplain, about 50 of which lie on the river side of the levees. For the river floodplain occurring in the six-county area of St. Clair, Monroe, Randolph, Jackson, Union, and Alexander, there are about 75 to 100 known sites considered "high priority." These consist of mounds, villages, rock shelters, camps, chipping areas, at least one flint quarry, and stone-box grave sites of prehistoric cemeteries.

<u>Missouri archeological resources</u>

205. Archeological sites in Missouri are more precisely displayed in Figure 20 (10 sheets) than those for the Illinois side of the floodplain. Sites are numbered from north to south as MA1** through MA16. The Smithsonian Institution numbering system with a three-part number is also included. The first two numbers indicate the state (in the case of Missouri, 23). The letter code, usually two letters, but in one case (Ste. Genevieve County) three letters, indicates the county location. The last digit(s) indicates the order in which the site was numbered, usually beginning with 1 and progressing chronologically to higher numbers. Thus, 23 SL 10 indicates the site is in Missouri, is in St. Louis county, and is the 10th site numbered in St. Louis County.

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* Abbreviation for "Illinois Archeological Site No. 1."
** Abbreviation for "Missouri Archeological Site No. 1."

206. In most parts of Missouri, systematic archeological surveys have not been done; thus it must be remembered that the absence of a numbered archeological site does not mean that one does not exist, but simply that it has not been located and numbered.

207. Missouri archeological information was obtained from the Archeological Survey of Missouri. Additional information may be found by reference to (a) the index of the Missouri Archeological Society publications, and (b) a publication of the University of Missouri-Columbia Extension Division on site preservation. The bulk of bibliographical sources for Missouri archeology are included in this publication's index.

208. Archeological remains in the Mississippi River floodplain range in age from Paleo Indian occupation, which could date as much as 10,000 yr ago, through the Archic and Woodland periods and also periods of occupation by the Mississippian cultures. The Bushbur Petroglyph site, MA3 (23JE367), is probably a Middle-Mississippian Petroglyph site; part of the carvings can only be seen at low water.

209. Numerous sites along the Mississippi River are currently listed on the National Register of Historic Places with the National Park Service as a result of the Historic Preservation Act of 1966. These include the Common Field Site, MA14 (23STG100); the Saltpan Kreilich site, MA15 (23STG5); and a site located in Trail of Tears State Park, MA16 (23CG37), in the vicinity of the river crossing of the Trail of Tears.

210. Archeological sites within or near the floodplain in Missouri are listed in north-to-south sequence as follows:

<u>a</u>. St. Louis County:

(1) MA1 - (23SL140). A village site on the left bank of the Meramec River.

(2) MA2 - (23SL10). A Kendell campsite at the foot of a bluff, west of the Missouri-Pacific Railroad tracks, on the north side of the Meramec River.

<u>b</u>. Jefferson County:

(1) MA3 - (23JE367). A petroglyph site with over 180 carvings found along a 900-yd stretch of the Mississippi River. The site periodically floods during high-water stages of the river.

(2) MA4 - (23JE1). A village and mound site south of the confluence of Joachim Creek and the Mississippi River, ascribed to the Woodland and Mississippian cultures. (23JE2). Two mounds and part of a group of three overlapping mounds.

(3) MA5 - (23JE3). A site consisting of two mounds with no, as yet, ascribed cultural affiliation.

(4) MA6 - (23JE198). A probable Paleo Indian site as evidenced by the presence of a fluted point.

(5) MA7 - (23JE11). An 80- by 8-ft mound directly overlooking the Mississippi River and ascribed to both the Woodland and Mississippian cultures.

c. Ste. Genevieve County:

(1) MA8 - (23STG1). A village site on the right bank of Isle de Bois Creek.

(2) MA9 - (23STG8). A village site on the left bank of Morrison Hollow Creek.

(3) MA10 - (23STG95). A mound on a bluff top in Brickeye Hollow.

(4) MA11 - (23STG97). Two mounds, approximately 35 by 3 ft each, on the left bank of Staples Hollow Creek.

(5) MA12 - (23STG111). A shelter at the base of a bluff on the left bank of Establishment Creek.

(6) MA13 - (23STG68). A village site on a terrain on the right bank of Establishment Creek.

(7) MA14 - (23STG100). The Common Field Site on the National Register of Historic Places, consisting of five mounds on the bottoms of the Mississippi River. This is one of the largest and best preserved groups of mounds in southeastern Missouri; the mounds range in height from 2.6 to 13 ft and in diameter from 150 to 320 ft. They are ascribed to the Mississippi culture.

(8) MA15 - (23STG5). A National Register Site near a salt spring on a tributary of Saline Creek. The first occupants were probably a Woodland cultural group (ca. 500 A.D.), who were followed by early Mississippian peoples (ca. 1000 A.D.). The site was then settled by the French and historic Kaskaskia tribe in the early 1700's. Known as the Kreilich site.

d. Perry County: There are five numbered sites in Perry County, none of which occur in the area of interest.

e. Cape Girardeau County: MA16 - (23CG37). A National Register Site that was extensively occupied in Woodland times and in the Mississippian and early historic periods. It was near here that the Cherokee Indians passed in 1838-1839 from their reservations in Tennessee, Georgia, and Alabama to the Indian Territory in present-day Oklahoma.

f. Scott County: There are 102 sites known in the county, none of which are on the river side of the levee.

g. Mississippi County: There are 92 known sites in the county, none of which are on the river side of the levee.

211. No known sites are listed for Scott and Mississippi Counties within the first levee, but there are some in the vicinity of the levee. Extensive survey work has been conducted in Mississippi County, and numerous sites have been found along abandoned river channels in the area.

212. Specific information on locations of Missouri archeologic sites is neither published nor distributed to individuals because of the potential vandalism that can occur through looting and wanton digging. Thus, locations of archeological sites are deliberately generalized to avoid site exposure.

Historical Elements

213. Historical sites within the floodplain of the Mississippi River are numerous. A large concentration of sites exists in cities and towns and are not considered here, as it is assumed that cities and towns of significant size will not be seriously affected by river modifications. Historical information is typically incomplete, and persons are advised to contact the appropriate addresses listed in Appendix A for final verification of historical elements.

Illinois historical areas

214. Information on historical and architectural sites in Illinois was obtained from the Illinois Historic Landmarks Survey.* This agency can provide additional information about an area if greater

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* For address see Appendix A.

project definition is given. However, much of the study region has been inadequately surveyed, and information is incomplete for Randolph and Union Counties. No information is available for Jackson County.

215. Areas of historical importance are plotted in Figure 20 (10 sheets) as sites IH1* through IH9. Since many of these areas are large and of uncertain extent or character, more detailed investigation may be necessary. These sites are listed as follows:

- a. IH1 - Saltpeter cave.
- b. IH2 - Modoc Rock Shelter listed on National Register of Historic Places.
- c. IH3 - Early settlement dwellings.
- d. IH4 - Early settlement dwellings
- e. IH5 - A large area designated in Figure 20, sheets 3 and 4, that includes IH2, IH3, and IH4. This area is regarded as being extremely important, although the reason was not stated. The area includes Fort de Chartres which is listed on The National Register of Historic Places.
- f. IH6 - Important historic area; reason not stated.
- g. IH7 - Alexander County Courthouse.
- h. IH8 - Mississippi River Missouri Pacific Railroad Bridge.
- i. IH9 - National Natural Landmark.

Missouri historical areas

216. Information on items of historical or architectural importance in Missouri was obtained from the State Historical Survey and Planning Office.** This office avoided noting sites in towns and cities as a general rule. Most, but not all, sites noted lie within the floodplain. More detailed information is available upon request from the state.

217. Areas of historic importance are plotted in Figure 20 (10 sheets). In contrast with Illinois, historical information is more precise as regards nature and location of sites. Sites are numbered MH1† through MH12 as follows:

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* Abbreviation for Illinois Historic Site No. 1.
** For address see Appendix A.
† Abbreviation for Missouri Historic Site No. 1.

a. MH1 - Jefferson Barracks; listed on National Register of Historic Places.

b. MH2 - Kimmswick; historic river town under study for Register.

c. MH3 - Hilltop Mansion.

d. MH4 - Indian rock paintings.

e. MH5 - "Greystone," gothic rural country house under study for Register.

f. MH6 - Ste. Genevieve; entire town is a National Historic Landmark.

g. MH7 - Important area around St. Marys; nature and boundaries highly uncertain.

h. MH8 - Wittenbery; 19th Century river town.

i. MH9 - Tower Rock (island); listed on National Register of Historic Places.

j. MH10 - Early concrete roadway.

k. MH11 - Old river town and railroad transfer point (19th century).

l. MH12 - Railroad transfer yards (19th century).

Outdoor Recreation

General description

218. The Middle Mississippi River from just south of St. Louis, Missouri, to Commerce, Missouri, is included in the "Ozark Highlands," 1 of 10 distinct types of recreational landscapes that have been identified in the Upper Mississippi River Basin.[43]

219. The Ozark Highlands lends itself to outdoor recreation. It is a well-dissected, nonglaciated plateau with gently to strongly rolling topography formed by sharply incised meandering streams. Most of the land area is covered with generous stands of hardwoods.

220. The steep, rocky topography has imposed obstacles to farming, transportation, and industrialization, resulting in limited modifications to the physical landscape. Approximately 12 percent of the area has been devoted to state parks and national forest areas, emphasizing the recreational value of the Ozark Highlands.[43]

221. Other than topography, climate also has an effect on recreation. July temperatures at Cairo, Illinois, average about 80°F and January temperatures average about 35°F. The climate in the study area, characterized in terms of a "discomfort index" based on the aggregate effects of temperature and humidity, is not as favorable during the summer months as areas farther north in Minnesota and Wisconsin. Sunshine is important to recreation, too, and from 100 to 140 clear days annually can be expected.

222. Population, income, employment, leisure time, and mobility have considerable effects on the demand for recreational facilities. Age composition, sex ratio, health, education, and place of residence influence the type and level of activity pursued.

223. The study area from St. Louis to Cairo is dominated by the large population of St. Louis, Missouri. It is instructive to list 1970 census figures[33,34] for cities along the Mississippi River from north to south.

Location	1970 Urban Population
St. Louis (Mo.-Ill.) Standard Metropolitan Statistical Area (SMSA)	2,363,017
Festus, Mo.	7,530
Ste. Genevieve, Mo.	4,468
Chester, Ill.	5,310
Cape Girardeau, Mo.	31,282
Cairo, Ill.	6,277
Total	2,417,884

224. The St. Louis area population, expected to reach 7.5 million persons by 2020, is the overwhelming factor in the demand for recreational facilities in this area and makes it particularly important that recreational aspects be given considerable weight in the northern half of the study area. The general trend is increasing urban population, correlated with decreasing numbers of rural or farm residents. The overwhelming portion of the St. Louis to Cairo study area in general, and the floodplain in particular, is rural, consisting of farms or very small towns.

225. Personal income is expected to continue to show considerable gain. However, the Upper Mississippi River Basin will remain behind the national average, particularly in rural areas. Participation in outdoor activities shows a marked increase beyond an annual income of $3000 and, with projections most favorable for the larger urban areas, St. Louis should increasingly dominate in demand for recreational facilities within the study area.

226. Employment influences the rate of participation in outdoor activities and rates for professional and technical workers are more than double that of farm workers. Population and occupation shifts in future decades will necessarily increase overall participation rates. Employment trends also indicate that more leisure time will be available in the future and will stimulate this demand for recreation. The UMRCRBS outdoor recreation resources review studies[43] indicate that at least one-fifth of all free time is spent in outdoor recreational activities, and this trend is expected to continue.

227. Access to recreational facilities is an important factor in their use. Highways constitute the primary facility linking population centers and recreational resources. Results of various studies show that (a) 80 percent of summer Sunday total mileage is recreational driving, (b) driving for pleasure accounts for 34 percent of all automobile travel, and (c) one-fourth of all intercity trips are for social or recreational purposes. Because of recent shortages and increasing cost of gasoline, these statistics may be changing rapidly. The study area is fortunate in having the recently completed Interstate Highway 55 closely paralleling the Mississippi River from St. Louis to Cairo, thereby making access to the river considerably easier for St. Louis residents. Once in the area, however, relatively few public access facilities are available.

<u>The recreation market</u>

228. The UMRCBS divides the Basin into five "planning units" for its outdoor recreation resources review.[43] Planning Unit C consists of the southernmost part of the Basin and includes St. Louis and the Mississippi River to Cairo, Illinois. The requirements that may be levied

on Mississippi River floodplain areas can be surmised from the data available for the entire Planning Unit C. In 1960 Unit C generated a demand of 235 million activity occasions.* This demand is expected to increase to 978 million activity occasions by 2020. Sixty-six percent of this Unit's demand originates in the St. Louis SMSA. Excellent opportunities for expanding recreational facilities exist, and it can be expected that Mississippi River floodplain areas have considerable potential. Upper Mississippi River Basin unsatisfied demand will continue to increase, however, if present supply is not increased. This trend is illustrated in Figure 21.[43] Estimates of projected demand and existing and potential capacity were used to generate this figure.

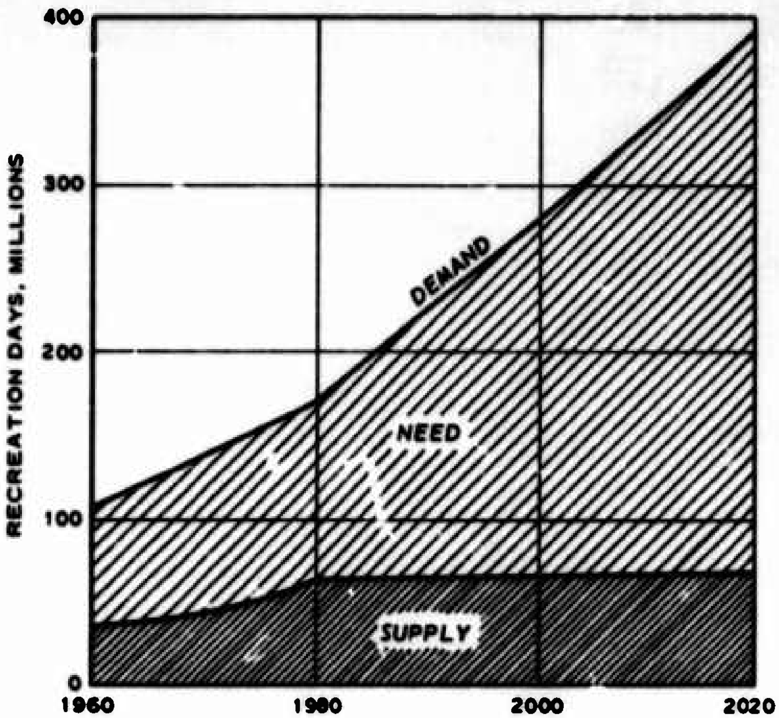

Figure 21. Planning Unit C (Southern) demand, supply, and needs for recreation[41]

229. Demand as to type of activity to expect is illustrated by Fig. 22.[43] Some of the activities, such as skiing, sledding, and

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* One "activity occasion" is defined as participation by an individual in any one activity during any part of a 24-hr period; participation in three activities in a single day would constitute three activity occasions.

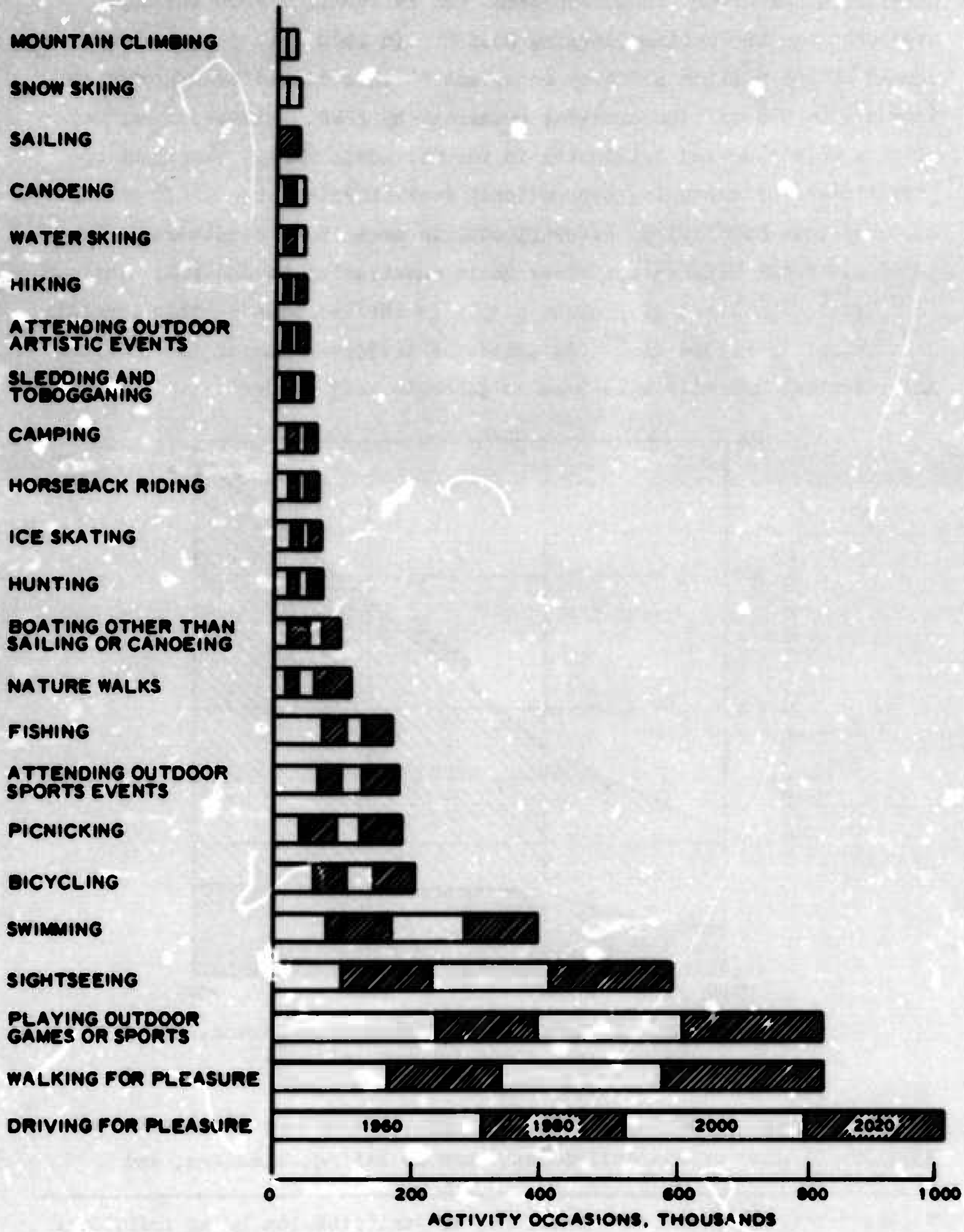

Figure 22. Upper Mississippi River Basin 1960-2020 projected annual participation in recreational activities (12 yr and older)[41]

and tobogganing, do not really apply as far south as St. Louis or Cairo, but the relative importance of most activities is portrayed. Water-related activities include swimming, canoeing, sailing, other boating, water skiing, picnicking, camping, sightseeing, nature walks, and hiking. Recreational boating is a fast-growing activity, and increasing affluence and leisure time have greatly increased boat ownership. A total Basin analysis indicates that it takes 2.5 acres of water surface to support one boat. The tabulation below[42] compares recreational boating statistics for 1960 in the Basin states and indicates that Illinois and Missouri rank fairly low in per capita boat ownership. Increased boating opportunities are largely responsible for boater participation.

	Ill.	Mo.	Ind.	Iowa	Wis.	Minn.
Population, thousands	10,081	4,319	4,662	2,758	3,951	3,413
Registered boats, thousands	155	60	133	72	241	252
Water surface, square miles*	543	404	86	494	1,439	4,779
Per capita income, dollars	2,650	2,115	2,188	1,986	2,175	2,116
Per capita ownership, percent	1.5	1.4	2.8	2.6	6.1	7.4

* Excludes Great Lakes waters.

230. Illinois and Missouri have already designated that portion of the Mississippi River between St. Louis and Cairo as a "Scenic River."* Use of such an area is largely a function of access from the major highways, such as Interstate Highway 55, to the water's edge. "Scenic Highways" also exist along both sides of the Mississippi River within the study area as illustrated in Figure 23.

231. Other existing recreational facilities and points of interest are also noted in Figure 23.[44,45] Some of these do not lie within the floodplain, but are noted to gain a better impression of the facilities available near this portion of the Mississippi River. Generally speaking the Mississippi River between St. Louis and Cairo offers few areas developed for a large volume of public recreation. Interstate Highway 55 has only recently been completed, and the longer travel times

* A Scenic River area is a section of river that is free of impoundments with shorelines or watersheds that are still largely primative and shorelines largely undeveloped, but accessible in places by road.

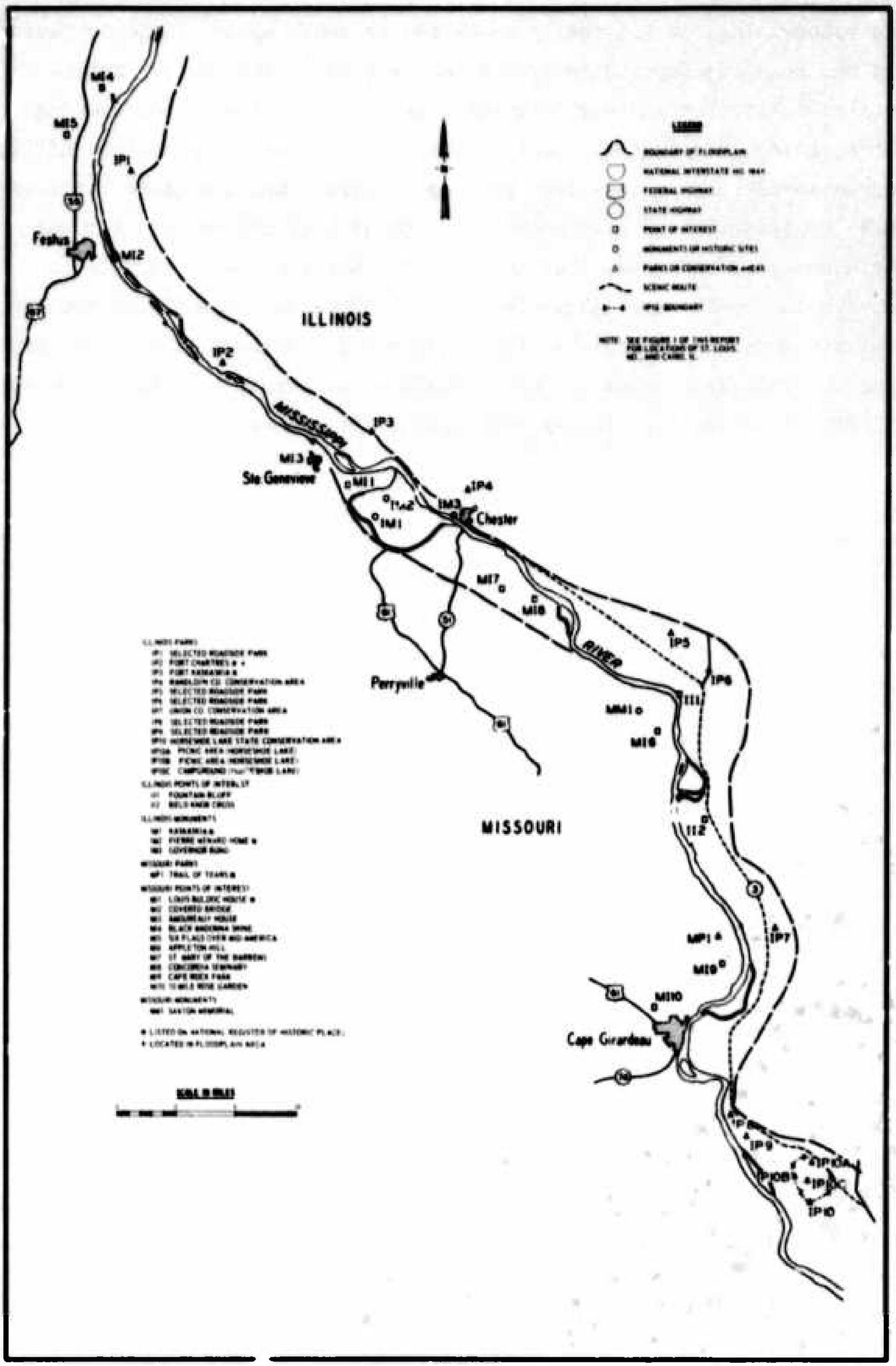

Figure 23. Recreation facilities and points of interest in the Middle Mississippi River region

in previous years probably discouraged travel to sites along the river. River areas north of St. Louis are more favorable than those to the south in many cases, since navigation impoundments lend themselves more readily to boating activities. The study area has also lagged somewhat in recreational facilities because it has only minimal tourist interest when compared with other possible areas that a traveller might visit.

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Table 1

Summary of Climatological Data for Selected Weather Stations

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Average Precipitation, in., 1900-1972													
St. Louis	2.10	2.10	3.14	3.96	3.80	3.72	3.16	3.45	3.46	2.86	2.44	2.27	36.80
Chester	2.96	2.32	3.46	4.23	4.21	3.98	3.13	3.70	3.31	2.76	3.00	2.70	39.11
Cairo	4.04	3.28	4.39	4.14	4.25	3.89	3.11	3.31	3.34	2.92	3.48	3.56	43.91
Temperatures, deg F, 1900-1972*													
St. Louis, Missouri													
Ave. Max.	39.8	43.3	53.4	65.7	75.4	84.4	88.5	86.8	79.9	68.6	53.8	43.0	65.2
Ave. Min.	23.2	26.1	34.9	46.4	56.3	65.7	70.0	68.0	60.6	49.2	36.7	27.7	47.4
Mean	31.5	34.8	44.2	56.1	65.9	75.1	79.3	77.5	70.3	58.9	45.3	35.4	56.3
Cairo, Illinois													
Ave. Max.	43.1	46.7	56.2	67.7	76.9	85.2	88.4	88.1	81.9	71.4	56.3	56.2	67.1
Ave. Min.	28.4	31.1	39.4	50.3	59.1	67.6	71.2	69.3	62.7	51.2	39.6	31.7	50.2
Mean	36.1	39.0	47.7	59.2	67.9	76.4	79.6	78.2	71.8	60.8	48.0	39.0	58.7
Record Temperatures, deg F													
St. Louis, Missouri													
Max.	75	76	87	91	98	104	112	106	107	93	83	75	112
Min.	-12	-8	5	20	35	48	56	54	36	27	7	1	-12
Cairo, Illinois													
Max.	75	73	82	88	98	104	104	103	103	92	82	73	104
Min.	3	-5	7	30	39	51	54	53	42	29	5	5	-5

* Yearly figures based on 1900-1963 data.

Table 2

Summary of Tornado Data for States in Upper Mississippi River Basin,* 1916-1950 [27,30,31]**

State	Totals for the Period				Annual Averages for the Period				Rank in Number of Tornadoes Reported	
	No.	Days†	Deaths	Damage	No.	Days†	Deaths	Damage	Among States	Adjustment for State Area††
Illinois	104	106	914	$48,705,650	2.97	3.03	26.11	$1,391,590	10	12
Iowa	498	257	83	19,565,505	14.23	7.34	2.37	559.014	2	1
Minnesota	117	92	162	17,859,300	3.34	2.63	4.63	510,266	17	23
Missouri	273	165	459	44,854,700	7.80	4.72	13.11	1,281,563	6	7
Wisconsin	123	91	105	10,205,100	3.51	2.60	3.00	291,574	16	18

* Includes all of the Mississippi River Basin from Cairo, Illinois, northward.
** Data for the period 1950-1970 is available in Reference 32.
† Total number of days on which tornadoes occurred for the period 1916-1950.
†† Ranking based on the unit area per tornado assuming a uniform distribution of occurrence.

Table 3

Hail Insurance Statistics for the Upper Mississippi River Basin,*

1960-1965 Average[27]

	Wisconsin	Minnesota	Illinois	Iowa	Missouri	5 States
Losses	$ 801,948	$3,769,212	$ 7,732,743	$ 8,833,954	$1,526,948	$22,331,473
Premiums	1,003,997	5,656,587	10,639,992	13,416,896	2,069,542	33,882,681
Coverage (insured value) (thousands)	44,015	98,331	610,686	391,432	84,628	1,229,092
Value of crops (actual value) (thousands)**	466,378	797,951	1,416,691	1,304,884	645,382	4,631,288

* Includes all of the Mississippi River Basin from Cairo, Illinois, northward.
** Valuation on farm, before marketing.

Table 4

Population Data for States and Counties Bordering the Middle Mississippi River Floodplain[33,34]

Counties	Area square miles	Population	Density Population square miles	Percent Change 1960-1970
		Missouri*		
St. Louis	499	951,353	1,906.5	+35.2
Jefferson	668	105,248	157.6	+58.6
Ste. Genevieve	499	12,867	25.8	+6.2
Perry	471	14,393	30.6	-1.7
Cape Girardeau	574	49,350	86.0	+17.4
Scott	421	33,250	79.0	+1.5
		Illinois**		
St. Clair	673	285,176	423.7	+10.4
Monroe	382	18,831	49.3	+21.4
Randolph	594	31,379	52.8	+4.6
Jackson	605	55,008	90.9	+30.5
Union	416	16,071	38.6	-8.9
Alexander	862	70,861	82.2	+3.5

* For the state, 1970 population density/square mile = 67.8; percent increase 1960-1970 = 8.3.

** For the state, 1970 population density/square mile = 199.4; percent increase 1960-1970 = 10.2.

Table 5

Populations for Missouri Townships Bordering the Middle Mississippi River Floodplain

	Population 1970	Population 1960		Population 1970	Population 1960
Jefferson County			**Cape Girardeau County**		
Joachim	21,938	18,080	Cape Girardeau	32,903	26,449
Plattin	4,487	3,260	(Cape Girardeau)	(31,282)	(24,947)
Rock	44,671	21,801	Randol	1,229	1,374
			Shawnee	1,597	1,682
Ste. Genevieve County			**Scott County**		
Beauvais	1,649	1,638	Commerce	647	734
Jackson	1,705	1,381	Kelso	8,708	8,129
Ste. Genevieve	7,851	7,419	Tywappity	491	706
(Ste. Genevieve)*	(4,468)**	(4,443)			
Saline	731	680			
Perry County			**Mississippi County**		
Bois Brale	829	1,025	Tywappity	6,739	8,281
Brazeau	1,204	1,332	(Charleston City)	(5,131)	(5,911)
Salem	681	783			
Saline	1,055	995			
			TOTAL: 1970 - 139,115		
			1960 - 105,749		

* Listings in parentheses are cities.

** Figures in parentheses are included in township figures immediately above.

Table 6

Populations for Illinois Townships Bordering the Middle Mississippi River Floodplain

	Population 1970	Population 1960		Population 1970	Population 1960
Monroe County			Union County		
Columbia	5,683	4,303	Preston	103	131
Harrisonville	1,066	1,060	Reynolds	166	185
Mitchie	504	564	Union	694	806
Moredock	396	402			
Renault	1,074	1,065			
Randolph County			Alexander County		
Brewerville	414	426	Cache No. 1	166	445
Chester	8,157	8,633	Cache No. 2	606	983
(Chesterville)*	(5,310)**	(4,460)	McClure	1,075	879
Kaskaskia	293	369	Santa Fe	146	226
Prarie DuRocher	1,113	1,219	Thebes	830	883
(Prarie DuRocher)	(658)	(679)	(Thebes)	(442)	(471)
Rockwood	234	365			
Jackson County					
Degognia	1,273	1,109			
Fountain Bluff	415	469			
Grand Tower	893	1,054	TOTAL: 1970 - 25,301		
(Grand Tower)	(664)	(847)	1960 - 25,576		

* Listings in parentheses are cities.
** Figures in parentheses are included in township figures immediately above.

Table 7

Population Migration in Missouri and Illinois, 1950-1970

Date	State			Urban				Rural			Percent of Total	
		Change from Preceding Census				Change from Preceding Census			Change from Preceding Census			
	Population	No.	Per-cent	Places of 2500 or More	Population	No.	Per-cent	Population	No.	Per-cent	Urban	Rural
					Missouri							
1 Apr 1970	4,676,501	356,688	8.3	166	3,277,662	401,105	13.9	1,398,839	-44,417	-3.1	70.1	29.9
1 Apr 1960	4,319,813	365,160	9.2	145	2,876,557	443,842	18.2	1,443,256	-78,682	-5.2	66.6	33.4
1 Apr 1950	3,954,653	169,989	4.5	108	2,432,715	--	--	1,521,938	--	--	61.5	38.5
					Illinois							
1 Apr 1970	11,113,976	1,032,818	10.2	383	9,229,821	1,089,155	13.4	1,884,155	-56,688	-2.9	83.0	17.0
1 Apr 1960	10,081,158	1,368,982	15.7	327	8,140,315	1,381,044	20.4	1,940,843	-12,062	-0.6	80.7	19.3
1 Apr 1950	8,712,176	814,935	10.3	258	6,759,271	--	--	1,952,905	--	--	77.6	22.4

Table 8

Personal Income Characteristics of Population of State of Missouri and Selected Counties Bordering the Middle Mississippi River, 1970 Census[36]

	Rural Nonfarm						
	Jefferson	Ste. Genevieve	Perry	Cape Giradeau	Scott	Mississippi	State
			1969 Income				
Median income of families (dollars)	9,899	7,916	6,467	7,191	6,666	4,497	7,172
Mean income of families (dollars)	10,251	8,333	7,294	7,788	7,340	5,603	8,080
			Income < Poverty Level				
Number of families	1,339	192	252	278	650	573	47,025
Percent of families	6.6	15.0	19.0	15.0	19.3	40.9	17.9
Number of unrelated individuals	1,160	144	270	258	379	235	42,172
Percent of unrelated individuals	44.0	56.0	70.5	54.0	57.1	71.6	59.5

(Continued)

Table 8 (Concluded)

	Rural Farm						
	Jefferson	Ste. Genevieve	Perry	Cape Giradeau	Scott	Mississippi	State
			1969 Income				
Median income of families, (dollars)	8,950	7,129	5,574	6,180	7,802	5,671	6,414
Mean income of families, (dollars)	9,730	8,372	6,372	7,489	10,332	6,564	7,926
			Income < Poverty Level				
Number of families	215	92	181	299	113	167	19,621
Percent of families	11.4	13.3	17.2	18.3	14.8	26.1	16.7
Number of unrelated individuals	128	28	40	85	57	46	6,464
Percent of unrelated individuals	45.6	--	--	43.4	51.8	41.8	43.8

Table 9

Personal Income Characteristics for Population of the State of Illinois and Counties Bordering the Middle Mississippi River, 1970 Census[37]

	Monroe	Randolph	Jackson	Union	Alexander	State
Rural Nonfarm						
1969 Income						
Median income of families (dollars)	8,503	8,952	7,739	6,535	5,608	9,516
Mean incomes of families (dollars)	9,162	9,350	8,653	7,758	6,263	10,378
Incomes < Poverty Level						
Number of families	118	274	579	439	328	32,871
Percent of families	8.1	8.5	14.5	19.8	32.6	9.3
Number of unrelated individuals	117	547	1,326	345	202	39,922
Percent of unrelated individuals	53.2	61.0	60.8	60.4	72.4	48.7
Rural Farm						
1969 Income						
Median incomes of families (dollars)	9,333	7,753	7,972	7,168	3,717	8,548
Mean incomes of families (dollars)	10,130	8,467	9,628	8,607	4,888	10,152
Incomes < Poverty Level						
Number of families	102	158	122	86	183	13,646
Percent of families	9.0	11.6	13.7	11.2	31.4	9.9
Number of unrelated individuals	22	63	83	37	69	6,843
Percent of unrelated individuals	19.6	39.6	44.1	--	56.1	36.2

Table 10

Employment Characteristics for Population of Missouri Counties on the Middle Mississippi River Floodplain, 1970 Census

		Percent in Labor Force						Employed Persons					Families		
			Married Women, Husband Present		Male									Percent with Income of-	
State	Nonworker-Worker Ratio	Female, 16 Years and Over	Total	With Own Children Under 6 Years	18 to 24 Years	65 Years and Over	Civilian Labor Force-Percent Unemployed	Percent in Manufacturing Industries	Percent in White-collar Occupations	Percent Government Workers	During Census Week-Percent Working Outside County of Residence	Persons Who Worked in 1969-Percent Worked 50 to 52 Weeks	Median Income (dollars)	Less than Poverty Level	$15,000 or More
Missouri	1.46	41.0	39.4	30.9	75.8	25.4	4.2	24.4	46.9	14.8	23.4	58.3	8,914	11.5	17.1
Counties															
St. Louis	1.36	42.8	38.6	24.7	74.8	32.5	3.4	27.6	62.0	12.0	40.8	61.5	12,392	3.6	33.3
Jefferson	1.62	37.3	35.7	28.1	84.2	21.0	5.4	35.0	36.3	9.5	55.7	60.2	9,742	7.2	14.3
Ste. Genevieve	1.91	32.4	32.6	30.4	85.3	14.6	2.3	36.2	25.8	9.1	22.0	64.1	8,020	13.6	8.8
Perry	1.69	34.4	36.3	35.4	73.6	35.7	3.0	31.7	25.7	8.5	17.5	57.9	6,518	16.9	6.7
Cape Girardeau	1.39	41.5	41.4	38.1	60.5	25.8	4.1	19.9	44.4	15.2	10.3	54.2	8,155	11.3	12.5
Scott	1.68	39.8	41.0	39.2	75.1	13.3	3.8	21.2	37.9	13.0	17.8	60.3	7,288	16.1	11.0
Mississippi	2.17	33.7	37.5	29.7	70.8	10.0	7.3	18.2	30.8	14.2	15.3	49.0	4,933	33.4	5.8

Table 11

Employment Characteristics for Population of Illinois Counties on the Middle Mississippi River Floodplain, 1970 Census

State	Nonworker-Worker Ratio	Percent in Labor Force: Female, 16 Years and Over	Percent in Labor Force: Married Women, Husband Present: Total	Percent in Labor Force: Married Women, Husband Present: With Own Children Under 6 Years	Percent in Labor Force: Male: 18 to 24 Years	Percent in Labor Force: Male: 65 Years and Over	Civilian Labor Force-Percent Unemployed	Employed Persons: Percent in Manufacturing Industries	Employed Persons: Percent in White-collar Occupations	Employed Persons: Percent Government Workers	During Census Week-Percent Working Outside County of Residence	Persons Who Worked in 1969-Percent Worked 50 to 52 Weeks	Families: Median Income (dollars)	Families: Percent Income of- Less than Poverty Level	Families: Percent Income of- $15,000 or More
Illinois	1.37	43.3	39.8	26.5	74.4	27.9	3.7	30.3	49.1	13.1	13.1	58.8	10,959	7.7	26.4
Counties															
St. Clair	1.62	38.9	37.0	27.0	78.8	24.2	6.1	24.1	45.0	15.8	33.3	59.8	9,547	12.4	17.7
Monroe	1.61	33.5	33.3	23.0	85.9	29.0	2.8	20.3	35.5	11.9	46.9	67.7	9,352	7.4	14.5
Randolph	1.68	36.1	34.8	27.4	55.1	31.1	3.2	28.8	29.1	13.5	10.9	66.1	8,818	9.0	13.5
Jackson	1.64	38.6	40.2	34.0	39.1	23.3	4.9	12.0	53.6	[illegible]	8.4	39.2	7,918	14.1	14.8
Union	1.61	35.1	38.3	34.1	72.2	25.3	4.7	18.2	33.6	29.5	15.1	60.5	7,115	16.2	9.4
Alexander	1.86	35.5	34.4	26.8	77.9	23.8	8.3	15.9	37.6	17.9	13.2	53.5	5,471	31.2	8.3

Table 12

Occupation and Earnings Data Summary for Population of Missouri Counties on the Middle Mississippi River Floodplain, 1970 Census

Counties	St. Louis City	St. Louis	Jefferson	Ste. Genevieve	Perry	Cape Girardeau	Scott	Mississippi
Occupation								
Total employed, 16 yr old and over	231,765	384,409	37,563	4,243	5,110	19,572	11,820	4,781
Professional, technical, and kindred workers	25,413	76,618	3,571	314	323	2,586	1,138	435
Managers and administrators, except farm	10,444	41,473	2,339	284	266	1,819	1,122	308
Sales workers	11,730	39,127	1,776	159	280	1,681	742	263
Clerical and kindred workers	50,086	81,032	5,946	338	445	2,605	1,483	467
Craftsmen, foremen, and kindred workers	24,121	52,485	8,195	735	681	2,691	1,715	568
Operatives, except transport	40,153	33,486	7,488	969	1,146	2,671	1,936	825
Transport equipment operatives	9,970	12,019	2,234	301	320	891	788	148
Laborers, except farm	13,066	11,282	1,977	290	241	770	436	191
Farmers and farm managers	171	594	299	288	645	981	522	411
Farm laborers and farm foremen	514	541	122	37	134	274	246	512
Service workers, except private household*	39,839	33,097	3,407	476	572	2,261	1,491	455
Private household workers	6,258	2,655	209	52	57	342	201	198
Median Earnings in 1969 of Persons in Experienced Civilian Labor Force for Selected Occupation Groups (dollars)								
Male, 16 yr old and over with earnings**	[illegible],791	9,480	8,211	6,655	5,340	6,288	6,142	4,369
Professional, managerial, and kindred workers	8,716	12,552	9,719	8,659	7,677	8,871	8,357	6,886
Craftsmen, foremen, and kindred workers	7,856	9,781	9,185	7,758	6,400	7,130	6,571	5,099
Operatives, including transport	6,646	7,942	7,836	6,720	5,548	5,347	5,579	4,202
Laborers, except farm	5,517	5,627	6,588	5,329	3,625	4,393	4,404	3,050
Farmers and farm managers	6,100	5,138	3,167	5,286	2,957	2,977	6,882	5,517
Farm laborers, except unpaid, and farm foremen	2,385	2,833	--	--	2,636	2,340	2,533	2,884
Female, 16 yr old and over with earnings**	3,829	4,014	3,586	2,799	2,901	3,106	3,200	2,736
Clerical and kindred workers	4,425	4,381	4,036	3,113	3213	3,167	3,435	3,658
Operatives, including transport	3,836	4,325	3,843	3,448	3,250	3,475	3,462	2,961

* Includes allocated cases, not shown separately.
** Includes persons in other occupation groups, not shown separately.

Table 13

Occupation and Earnings for the Population of Illinois Counties on the Middle Mississippi River Floodplain, 1970 Census

Counties	St. Clair	Monroe	Randolph	Jackson	Union	Alexander
Occupation						
Total employed, 16 yr old and over	96,020	6,869	11,232	19,651	5,796	3,800
Professional, technical, and kindred workers	11,546	580	863	4,312	602	358
Managers and administrators, except farm	5,768	393	681	1,558	495	367
Sales workers	6,328	396	475	975	298	216
Clerical and kindred workers	19,527	1,072	1,249	3,681	550	489
Craftsmen, foremen, and kindred workers	14,254	1,303	2,173	1,875	797	383
Operatives, except transport	13,313	856	1,849	2,045	839	538
Transport equipment operatives	5,539	390	520	590	319	190
Laborers, except farm	5,234	350	641	701	334	219
Farmers and farm managers	1,061	613	801	460	322	98
Farm laborers and farm foremen	428	233	215	186	210	95
Service workers, except private household*	11,996	627	1,670	3,030	961	766
Private household workers	1,026	56	95	238	69	81
Median Earnings in 1969 of Persons of Experienced Civilian Labor Force for Selected Occupation Groups (dollars)						
Male, 16 yr old and over with earnings**	7,890	7,998	7,347	5,819	5,949	5,406
Professional, managerial and kindred workers	10,462	10,023	9,409	8,645	8,904	8,721
Craftsmen, foremen, and kindred workers	8,826	8,740	8,983	7,443	6,765	6,160
Operatives, including transport	7,487	7,997	7,055	5,112	5,438	5,179
Laborers, except farm	5,629	5,708	5,873	3,771	4,262	2,722
Farmers and farm managers	5,175	6,378	5,034	5,191	4,433	2,409
Farm laborers, except unpaid, and farm foremen	1,135	2,650	1,745	2,444	2,292	--
Female, 16 yr old and over with earnings**	3,684	3,498	3,196	2,855	3,549	2,791
Clerical and kindred workers	4,232	4,224	3,658	2,516	3,757	3,554
Operatives, including transport	3,752	2,705	3,608	3,639	3,598	2,795

* Includes allocated cases, not shown separately.

** Includes persons in other occupation groups, not shown separately.

Table 14

Projected Employment for Selected Manufacturing Industries by Standard Industrial Classification (SIC)[35]

Year	20-Food	28-Chem.	29-Petrol. Prod.	23-Stone Clay, Glass	33-Primary Metals	34, 35-Fabr. Met. & Nonelec. Mach.	Total
Plan Area 6: Kaskaskia River							
1960	9*	5	6	5	17	5	47
1980	9	6	4	5	19	6	49
2000	9	8	3	5	21	8	54
Plan Area 7: Big Muddy River							
1960	1	1	--	(c)	(c)	(c)	2
1980	1	1	--	(c)	(c)	(c)	2
2000	1	1	--	(c)	(c)	(c)	2
Plan Area 8: Meramec River							
1960	26	16	(c)	8	6	35	91
1980	27	20	(c)	8	6	44	105
2000	27	27	(c)	8	7	58	127

* All numbers are in thousands of employees.
(c) Less than 500 employees.

Table 15

Business Patterns for Missouri Counties Bordering the Middle Mississippi River, 1971 Data[39]

Industry	Number of Employees, Mid-March Pay Period	Taxable Payrolls, Jan-Mar $1,000	Total Reporting Units
Cape Girardeau County			
Total	14,244	20,348	1,152
Agricultural services, forestry, fisheries	24	20	7
Mining	80	123	4
Contract construction	1,043	2,110	113
Manufacturing	4,175	6,598	82
Transportation and other public utilities	1,014	2,236	46
Wholesale trade	1,092	1,883	118
Retail trade	3,545	3,627	379
Finance, insurance, and real estate	693	1,172	97
Services	2,524	2,517	296
Unclassified establishments	54	62	10
Scott County			
Total	6,604	8,217	678
Agricultural services, forestry, fisheries	62	24	7
Mining	(D)*	(D)	1
Contract construction	464	798	64
Manufacturing	2,004	2,290	35
Transportation and other public utilities	372	550	32
Wholesale trade	674	1,117	54
Retail trade	1,487	1,599	264
Finance, insurance, and real estate	406	600	50
Services	1,105	1,104	164
Unclassified establishments	(D)	(D)	7
Mississippi County			
Total	2,108	2,318	302
Agricultural services, forestry, fisheries	(D)	(D)	3
Contract construction	62	54	19
Manufacturing	633	649	14
Transportation and other public utilities	237	457	24
Wholesale trade	98	128	21
Retail trade	662	647	131
Finance, insurance, and real estate	83	101	25
Services	289	247	58
Unclassified establishments	(D)	(D)	7

(Continued)

* "D" denotes figures withheld to avoid disclosures of operations of individual reporting units.

Table 15 (Concluded)

Industry	Number of Employees, Mid-March Pay Period	Taxable Payrolls, Jan-Mar $1,000	Total Reporting Units
Jefferson County			
Total	10,742	16,786	1,072
Agricultural services, forestry, fisheries	43	75	8
Mining	126	283	8
Contract construction	656	1,247	152
Manufacturing	3,817	8,069	60
Transportation and other public utilities	624	1,184	49
Wholesale trade	367	667	56
Retail trade	2,588	2,684	381
Finance, insurance, and real estate	626	833	83
Services	1,799	1,636	257
Unclassified establishments	96	108	18
Ste. Genevieve County			
Total	2,869	4,059	199
Agricultural services, forestry, fisheries	(D)	(D)	1
Mining	17	16	4
Contract construction	165	344	11
Manufacturing	1,694	1,587	16
Transportation and other public utilities	170	278	8
Wholesale trade	25	46	9
Retail trade	471	466	82
Finance, insurance, and real estate	94	160	18
Services	224	178	48
Unclassified establishments	(D)	(D)	2
Perry County			
Total	2,886	3,284	282
Agricultural services, forestry, fisheries	8	13	3
Mining	(D)	(D)	1
Contract construction	353	767	27
Manufacturing	1,085	1,242	27
Transportation and other public utilities	83	80	11
Wholesale trade	66	82	16
Retail trade	792	690	119
Finance, insurance, and real estate	93	109	15
Services	379	272	59
Unclassified establishments	(D)	(D)	4

Table 16

Business Patterns for Illinois Counties Bordering the Middle Mississippi River, 1971 Data[38]

Industry	Number of Employees, mid-Mar Pay Period	Taxable Payrolls, Jan-Mar $1,000	Total Reporting Units
Monroe County			
Agricultural services, forestry, fisheries	3	3	3
Mining	(D)*	(D)	1
Contract construction	317	673	35
Manufacturing	90	126	12
Transportation and other public utilities	102	160	11
Wholesale trade	63	105	10
Retail trade	603	640	108
Finance, insurance, and real estate	154	203	25
Services	362	273	76
Unclassified establishments	(D)	(D)	4
Total	1820	2,380	285
Randolph County			
Agricultural services, forestry, fisheries	(D)	(D)	2
Mining	783	2,647	10
Contract construction	294	528	45
Manufacturing	3141	5,866	28
Transportation and other public utilities	595	1,489	37
Wholesale trade	273	647	29
Retail trade	1590	1,519	256
Finance, insurance, and real estate	239	320	39
Services	776	662	136
Unclassified establishments	(D)	(D)	6
Total	7729	13,729	588
Jackson County			
Agricultural services, forestry, fisheries	18	9	5
Mining	(D)	(D)	3
Contract construction	607	1,105	67
Manufacturing	1579	2,411	30
Transportation and other public utilities	639	1,147	39
Wholesale trade	374	585	41
Retail trade	3314	3,033	311
Finance, insurance, and real estate	736	974	86
Services	1833	1,889	259
Unclassified establishments	(D)	(D)	19
Total	9206	11,285	860

(Continued)

* "D" denotes figures withheld to avoid disclosure of operations of individual reporting units.

Table 16 (Concluded)

Industry	Number of Employees, mid-Mar Pay Period	Taxable Payrolls, Jan-Mar $1,000	Total Reporting Units
Union County			
Agricultural services, forestry, fisheries	(D)	(D)	1
Mining	(D)	(D)	1
Contract construction	113	260	20
Manufacturing	1021	1594	18
Transportation and other public utilities	213	378	23
Wholesale trade	149	196	19
Retail trade	538	547	124
Finance, insurance, and real estate	122	168	27
Services	396	381	39
Unclassified establishments	(D)	(D)	5
Total	2621	3622	327
Alexander County			
Agricultural services, forestry, fisheries	(D)	(D)	1
Contract construction	115	212	16
Manufacturing	900	943	11
Transportation and other public utilities	160	252	17
Wholesale trade	287	433	29
Retail trade	906	781	135
Finance, insurance, and real estate	131	183	16
Services	395	276	69
Unclassified establishments	(D)	(D)	2
Total	2906	3087	296

Table 17

Industry of Employed Persons By Size, 1970 Data

Industry	Number of Persons Employed: Total	Urban	Rural
		Illinois	
Agriculture, forestry, fisheries	118,371	19,098	99,273
Mining	20,955	9,709	11,246
Construction	225,649	176,784	48,865
Manufacturing	1,340,188	1,155,164	185,024
Transportation and other public utilities	269,998	235,992	34,006
Wholesale trade	185,536	165,811	19,725
Retail trade	706,728	607,756	98,972
Finance, insurance, and real estate	233,835	212,590	21,245
Service	914,399	794,655	119,744
		Missouri	
Agriculture, forestry, fisheries	89,564	11,121	78,443
Mining	10,502	4,156	6,346
Construction	103,632	64,361	39,271
Manufacturing	430,874	317,868	113,006
Transportation and other public utilities	111,114	85,308	25,806
Wholesale trade	87,147	72,804	14,343
Retail trade	293,553	220,927	72,626
Finance, insurance, and real estate	82,129	68,896	13,233
Service	535,427	418,487	116,940

Table 18

Projected Output (Value Added) for Selected Manufacturing Industries by Standard Industrial Classification (SIC)[35]

Year	20-Food	28-Chem.	291-Petrol. Ref.	324-Hyd. Cemt.	33-Primary Metals	34, 35-Fabr. Met. & Nonelec. Mach.	Total
Plan Area 6: Kaskaskia River							
1960	119*	90	104	--	220	59	593
1980	284	328	207	--	462	140	1,421
Plan Area 7: Big Muddy River							
1960	15	9	--	--	2	3	29
1980	43	25	--	--	6	8	82
Plan Area 8: Meramec River							
1960	408	317	--	19	63	369	1,176
1980	1,211	1,122	--	43	135	1,295	3,806

* All numbers are in millions of dollars.

Table 19

Commodity Group Tonnage Shipped on the Middle Mississippi River Between St. Louis, Missouri, and Cairo, Illinois, in 1971[41]

Commodity Group	Tonnage	Percentage of Total
Farm products	13,403,495	31.4
Petroleum and coal products	10,449,838	17.9
Coal	9,882,507	16.9
Chemicals and allied products	6,364,490	10.9
Nonmetallic minerals, except fuels	4,064,110	6.9
Food and kindred products	2,607,249	4.5
Primary metal products	1,998,857	3.4
Stone, clay, glass and concrete products	1,949,144	3.3
Special items	1,724,206	2.9
Waste and scrap materials	297,018	0.5
Fabricated metal products except ordnance machinery and transportation equipment	234,091	0.4
Metallic ores	213,633	0.3
Pulp, paper and allied products	153,330	0.26
Lumber and wood products except furniture	97,317	0.16
Machinery, except electrical	28,081	Negligible
Transportation equipment	21,961	Negligible
Fresh fish and other marine products	11,700	Negligible
Crude petroleum	9,118	Negligible
Basic textiles	6,459	Negligible
Electrical machinery, equipment and supplies	1,906	Negligible
Rubber and miscellaneous	140	Negligible
Forest products	103	Negligible
Furniture and fixtures	14	Negligible
Apparel and other finished textile products, including knit	Unknown	N/A
Printed matter	Unknown	N/A
Leather and leather products	Unknown	N/A
Miscellaneous products of manufacturing	Unknown	N/A
Total recorded tonnage	58,518,767	

Table 20

Index of Change for Projected Waterborne Commerce, Upper Mississippi River Basin*--
1980, 2000, and 2020 (Index 1960-64 = 100)[42]

Commodity	1960-64	1980			2000			2020		
	Average	Low	Medium	High	Low	Medium	High	Low	Medium	High
Selected grains	100	189	209	248	278	338	447	338	497	745
Bituminous Coal	100	130	142	166	118	158	213	103	142	237
Petroleum and petroleum products	100	71	83	92	96	129	166	118	172	247
Cement, stone, sand and gravel	100	146	163	182	182	215	268	206	263	332
Industrial chemicals and sulphur	100	195	222	286	326	467	703	499	825	1428
Agricultural chemicals	100	437	543	648	777	1053	1417	1101	1619	2267
Iron ore and iron and steel	100	159	182	217	228	283	391	283	387	580
Other and miscellaneous	100	129	164	214	199	269	393	313	438	642
Total	100	144	164	194	199	258	348	249	365	547

* Upper Mississippi River Basin includes the Mississippi waterway from Cairo, Illinois, northward.

APPENDIX A: ADDRESSES OF STATE AND PRIVATE OFFICES AS SOURCES OF ADDITIONAL INFORMATION

Information on geology, soils, archeological, and historical elements for specific areas in the Middle Mississippi River floodplain, often unavailable through technical publications, is frequently available through various state and Federal agency offices. Addresses of some of these offices are listed below.

Dr. John C. Frye, Chief
Illinois State Geological Survey
121 Natural Resources Building
Urbana, Illinois 61801

Dr. William C. Ackermann, Chief
Illinois State Water Survey
155 Water Resources Building
P. O. Box 232
Urbana, Illinois 61801

Mr. John C. Guillou
Chief, Waterways Engineer
Division of Water Resource Management
of Illinois, Department of Transportation
201 W. Monroe Street
Springfield, Illinois 62706

Missouri Geological Survey and Water Resources
P. O. Box 250
Rolla, Missouri 65401

Missouri Speleological Survey
Mr. Thomas F. Cravens
Department of Sociology
Meramec Community College
Kirkwood, Missouri 65201

Mr. Donald L. Wallace
Soil Scientist
U. S. Department of Agriculture
Soil Conservation Service
132 North Kansas Street
Edwardsville, Illinois 62025

Illinois Agricultural Experiment Station
University of Illinois
Urbana, Illinois 68101

Dr. Charles Bareis
Illinois Archeological Survey
109 Davenport Hall
University of Illinois
Urbana, Illinois 61801

Mr. David E. Evans
Archeological Survey of Missouri
Room 22, Switzler Hall
University of Missouri
Columbia, Missouri 65201

Mr. William G. Farrar, Director
Illinois Historic Landmarks Survey
320 South Main Street
Benton, Illinois 62812
telephone (618)439-4253

Mrs. William L. Holmes
Chief Architectural Historian
State Historical Survey and Planning Office
Suite 215, Columbia Professional Building
909 University Avenue
Columbia, Missouri 65201
telephone (314)449-0725

In accordance with ER 70-2-3, paragraph 6c(1)(b), dated 15 February 1973, a facsimile catalog card in Library of Congress format is reproduced below.

Stoll, Jack K

Inventory of physical and cultural elements, Middle Mississippi River floodplain (River Reach - St. Louis, Missouri, to Cairo, Illinois), by Jack K. Stoll [and] Robert D. Brown. Vicksburg, U. S. Army Engineer Waterways Experiment Station, 1975.

1 v. (various pagings) illus. 27 cm. (U. S. Waterways Experiment Station. Miscellaneous paper Y-75-1)

Prepared for U. S. Army Engineer District, St. Louis, St. Louis, Missouri.

Includes bibliography.

1. Environmental inventories. 2. Middle Mississippi River. 3. Mississippi River Floodplain. I. Brown, Robert D., joint author. II. U. S. Army Engineer District, St. Louis. (Series: U. S. Waterways Experiment Station, Vicksburg, Miss. Miscellaneous paper Y-75-1)

TA7.W34m no.Y-75-1